SURVIVAL

The Institute for Strategic Studies

SEPTEMBER-OCTOBER 1960 Volume 2 Number 5

SURVIVAL

VOL 2 NO 5 SEPTEMBER–OCTOBER 1960

Published by the Institute for Strategic Studies

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The articles in this issue are, with the exception of Dr Margerison's examination of the possibilities of aerial reconnaissance, all concerned with presenting a particular policy rather than with analysis or information. They deal with three of the most contentious problems of contemporary strategic policy – the nuclear test ban, the future of atomic weapons in NATO, *and the strengthening of its conventional forces.*

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The Case for Ending Nuclear Tests

HANS A. BETHE

From The Atlantic Monthly
August 1960

Dr Bethe, head of the Cornell Laboratory of Nuclear Studies, is one of America's leading nuclear physicists and has been scientific adviser to the United States delegation at the Geneva negotiations on the test ban treaty. He leads that wing of the divided American scientific community, of which the other is led by Dr Edward Teller, which believes that a test ban is both in the Western interest and can be effectively policed. This article is not only a vigorous defence of that point of view, but also a clear exposition of the problems that have been encountered in negotiating the treaty
(By permission of *The Atlantic Monthly*)

THE CESSATION of nuclear weapons tests has been debated in the newspapers, in Congress, and most of all, in Geneva, where there have been what I consider honest negotiations. Concrete proposals have been made by both sides, by the East and by the West; there has been a considerable measure of agreement between East and West; and a number of articles of a treaty have been accepted.

The fundamental points of view of the two sides on disarmament measures were quite different. The Soviet Union advocated just a piece of paper on which we would agree to reduce our armaments. The United States and Britain insisted on the verification of any treaty concerning the limitation of armaments.

Because of the Russian desire for secrecy, the West proposed that the verification of a test cessation agreement should be primarily by physical methods, which would mean less intrusion into the privacy of the Soviet Union. It is clear that the Russians have by now accepted the major principle on which the United States has insisted; namely, that there should be a control system for the test cessation agreement. This in itself is an important result of the negotiations, and we must not jeopardize this achievement by either breaking off the negotiations or by making unreasonable demands which we know Russia cannot fulfill.

The problem of detection of nuclear explosions varies with the medium in which the nuclear explosion is set off. Until recently, practically all the nuclear explosions were set off in the atmosphere, either on the ground or higher up. The best-known method for detection of nuclear explosions is the collection of radioactive debris, by planes flying in those regions where the debris is expected to arrive, or on the ground from fall-out. However, the collection of fall-out on the ground is quite unreliable, because the winds may carry the radioactive debris in one direction or another.

We can also detect a nuclear explosion by the acoustic method, which consists in recording the pressure wave created by the explosion. Though the pressure decreases as the wave passes through the atmosphere, it remains recordable to a distance of 10,000 miles. The wave is such a good indicator of nuclear explosions that the United States has usually announced Russian explosions very soon after they have taken place. We have announced far more Russian explosions than the Russians themselves. Similarly, the Russians have been able to detect our nuclear explosions.

To improve detection, it was proposed as part of a treaty on the cessation of nuclear tests to have a large number of stations in each country, especially in Russia, in the United States, and in the British Commonwealth, all equipped with detection instruments. With the network of stations worked out in the Geneva negotiations, it was generally agreed that we would be able to detect and identify explosions in air down to the level of one kiloton, or possibly lower.

The second medium in which nuclear explosions have been set off is underwater. Such explosions are, if anything, even easier to detect than those in air, because the pressure wave is very well

propagated through water, so much so that even an explosion of a few tons, not kilotons, can be recorded through water for thousands of miles.

Another location where nuclear tests might be carried out is in outer space. Detection there is considerably more difficult than in the air or in water, but it is confidently expected that one could detect nuclear weapons tests to distances of at least a million miles, which is four times the distance from here to the moon.

II

Underground testing is our most vexing problem and has received the most publicity. It has the obvious advantage that it does not contaminate the atmosphere, and therefore the great disadvantage, from a detection point of view, that radioactive air samples cannot be collected. From experience gained in Nevada, we know how deep an explosion has to be buried in order to prevent escape of radioactive material into the air. A kiloton bomb must be buried about four hundred feet underground; a twenty-kiloton bomb, about eleven hundred.

The displacement of the earth produced by an underground explosion is sufficiently great to be recorded easily by a seismograph, unless the explosion itself is very small. The two largest underground explosions to date were carried out in Nevada in the autumn of 1958. One of these was five kilotons and the other twenty; they could be observed on the seismographs throughout the United States, and the larger one gave a clear signal in Russia.

Unfortunately, underground explosions produce the same type of record as earthquakes; namely, seismograms consisting of a series of perhaps twenty wiggles. There are very few ways to distinguish between the two types of seismogram. The best distinguishing mark that seismologists have been able to find is the direction of the so-called first motion – whether the first wiggle starts up or down.

The criteria for distinguishing earthquakes from explosions were discussed in detail in the Geneva negotiations. It was decided that control stations should be set up at regular intervals of about six hundred miles in seismic regions – that is, regions in which earthquakes normally occur – and about a thousand miles in aseismic regions. This figures out to about twenty stations in the USSR.

It is estimated that one to two hundred earthquakes with a force equivalent to that of an explosion of twenty kilotons occur in the Soviet Union every year. Of these, about half would be distinguished from explosions by first motion and other features in the seismograms obtained in the Geneva network of stations. This leaves about fifty to a hundred earthquakes a year which cannot be distinguished from explosions.

The only sure way to tell an earthquake from an explosion is to send an inspection team to the location of the earth disturbance. A combination of seismograms from several stations can determine the location to an accuracy of about five miles. Thus, one would have to send an inspection team to explore an area of about a hundred square miles for evidence of an explosion. A number of scientists have tried to work out procedures for such an inspection.

How many inspection teams would have to be sent out every year? Would one inspect every one of the fifty to a hundred questionable events? I do not think so. It is generally agreed that about 30 per cent would suffice. This would mean about twenty inspections in the Soviet Union annually in order to monitor possible nuclear tests above twenty kilotons.

A detailed study of the problem has been made by Dr Richard Latter of the Rand Corporation. He finds that the capability of the control system would be greatly increased by distributing the stations somewhat differently from the pattern proposed in the Geneva negotiations and by increasing their number in Russia from twenty to thirty. This would make it much easier to distinguish earthquakes from explosions, so that only about ten earthquakes per year in the Soviet Union with a force equivalent to twenty kilotons or more will remain unidentified by their seismograms. Ten inspections would therefore cover all doubtful events equivalent to twenty kilotons or more. Forty inspections would make it possible to monitor all earthquakes above five kilotons. (A five-kiloton bomb is a small bomb. The Nagasaki bomb had a force of twenty kilotons.)

We must keep in mind, however, that our underground explosions in the past have been carried on in Nevada tuff, in a rock which is very soft and which therefore gives a relatively strong seismic signal. If the underground explosion is carried out in harder rock, such as salt, granite, or limestone, it creates a smaller signal. A signal which corresponds to a five-kiloton explosion in tuff may correspond to perhaps ten or fifteen kilotons in these harder types of rock. Even fifteen

kiloons is not a very large atomic explosion.

Our capability of detection and inspection of underground explosions under the Geneva or the Latter system would be quite satisfactory were it not for the possibility of deliberate concealment of explosions by a process known as decoupling, or muffling.

A very powerful method has been proposed by Dr Albert Latter, the brother of Dr Richard Latter. The method consists of making an enormous cavity underground and setting off the atomic bomb in the middle of the cavity. One can calculate that the apparent size of the explosion is thereby reduced by a factor of about 300.

Latter's decoupling theory was invented about January 1959 and was then checked by many scientists, including me. It was experimentally verified with small explosions of conventional high explosive in Louisiana early this year. To decouple the explosion of a twenty-kiloton weapon, a spherical hole of about fifty million cubic feet, or nearly five hundred feet in diameter, is necessary. Moreover, the hole has to be three thousand feet below ground. The big room of Carlsbad Caverns is only big enough to muffle ten kilotons.

It would obviously be very slow and very expensive to excavate such a hole by a normal mining operation, with pick and shovel and high explosives. However, in salt domes, large holes can be made by washing out the salt; that is, by pumping water in and pumping brine out. Experts of the oil industry have estimated that to excavate a hole big enough to muffle a twenty-kiloton explosion would take more than two years and would cost about ten million dollars. This is quite a lot of money, but the time factor is probably more important. The actual washing operation has to be preceded by an engineering study, and after completion of the hole, considerable time is required to set up and complete an atomic test.

Whether a five-hundred-foot hole in a salt dome could be maintained is not known. Holes of about one-tenth that volume are used to store oil and gasoline. It is also unknown whether a hole could be used repeatedly for nuclear testing.

I cannot imagine that the washing of a five-hundred-foot hole would go undetected, even in a closed country like the Soviet Union. Just the amount of salt water which would be carried up to the earth's surface is staggering, being many times the volume of the salt. Somehow this salt water must be disposed of. One possibility is to dump the brine directly into the sea or into depleted oil wells, but both of these methods severely limit the geographical areas in which the hole could be constructed. A more widely applicable method would be to dump it into a river. But even in a very big river, like the Ohio or the St Lawrence, the salt excavated from one big hole would double the salt content for a year. The increase would be very easy to discover by making a chemical analysis of the river water at regular intervals.

It is important that there are relatively few locations in which large holes can reasonably be dug; one needs salt domes and, in addition, ways to dispose of the salt water. In other types of rock, both excavation and disposal of the excavated material would be far more troublesome, and the resulting hole would probably be less safe and less reliable for decoupling. Luckily for inspection, the geographical regions where salt domes are known to exist are generally aseismic, so that any seismic signal originating from these regions would be suspicious. For the same reason, only a few inspections would be needed to guard against muffled shots. Of course, one first has to get a signal from a muffled explosion. How this can be done I shall discuss later.

III

The main question is: Does any country want to go to such an extreme as constructing the big hole in order to cheat on a test ban? Can we really assume that the Russians would go to the trouble of negotiating a test cessation treaty just in order to turn around the next day and violate it?

Having participated in the negotiations with the Russian scientists at Geneva on three occasions, I believe that they are sincere in wanting the test cessation agreement and do not intend to cheat on it. For instance, in November 1959, although the Russians were in many ways reluctant to agree with the American delegation, they were very eager to accept any improvements in detection apparatus suggested by the Americans. If the Russians wished to violate the treaty, they would have objected to these improvements.

Many other Americans, without disagreeing on any of the scientific facts, believe that the Russians are bent on violation, and they therefore oppose the cessation of testing. Dr Edward Teller has argued this point repeatedly, and in particular in his television discussions with Bertrand Russell. His line of reasoning runs as follows: 'We cannot detect Russian underground tests of bombs of

small yield; since we cannot detect these tests, we should assume that they are carrying out such tests. If they carry out such tests and we do not, then they will soon be ahead of us in the area of small nuclear weapons. When they are ahead of us in this area, they will have military superiority, and thereby they can blackmail us into complete submission. At that moment the whole free world will have to capitulate to Russian Communism.'

It seems to me this is a series of non sequiturs. Every one of these steps, I think, is very unlikely. I do not think the Russians intend to violate a treaty banning weapons tests; I do not think that the Russians could risk cheating, even if there is only a small likelihood of being detected. Even if we had no system of physical stations detecting nuclear tests, the Russians would not risk having some defector tell us about a clandestine nuclear explosion. If there were such a defector telling us of a Russian violation, it would not be very difficult to find physical evidence of it. I believe that the Soviet Union, which is posing as a peace-loving nation, whether rightly or wrongly, simply cannot afford to be caught in a violation, and therefore I think that it will not try to cheat.

But even supposing that the Russians wanted to cheat, what would they need to do? One violation, one nuclear test below ground, does not do much for the development of weapons. In the first place, they would have to develop entirely new methods to assess the results of a nuclear test. Most of the methods commonly used for observing the results of a test in air do not work underground. Probably several explosions of weapons whose performance is already known are required to develop methods of observation underground. Second, two or more test explosions are often needed to develop a single new weapon. Finally, a country which already has dozens of types of weapons will hardly be interested in developing just one more, in violation of a treaty. For all these reasons, a potential violator of the treaty would only be interested if he could perform a whole series of tests.

Now, if a series of tests were carried out, all at the same location, this would greatly simplify the work of the detecting agency. It would merely be necessary to detect the disturbances on the seismograph, not to distinguish them from earthquakes. The fact of repeated seismic disturbances originating from the same location (except as aftershocks of one big earthquake) would be sufficiently suspicious to warrant dispatching an inspection team to their site. With our accepted Geneva system of twenty stations in the Soviet Union, it is generally agreed that we could record disturbances underground of less than one kiloton. Thus, to violate the treaty without being detected, it would be necessary to find a new location for practically every test in the series. The development of a new test site would add enormously to the cost, complexity, and inconvenience of testing.

IV

I had the doubtful honour of presenting the theory of the big hole to the Russians in Geneva in November 1959. I felt deeply embarrassed in so doing, because it implied that we considered the Russians capable of cheating on a massive scale. I think that they would have been quite justified if they had considered this an insult and had walked out of the negotiations in disgust.

The Russians seemed stunned by the theory of the big hole. In private, they took the Americans to task for having spent the last year inventing methods to cheat on a nuclear test cessation agreement. Officially, they spent considerable effort in trying to disprove the theory of the big hole. This is not the reaction of a country that is bent on cheating.

Two of the Russian scientists presented to the Geneva Conference their supposed proof that the big hole would not work. A day or two later, Dr Latter and I gave the counterproof and showed, with the help of the Russian theory itself, that the Russian proof was wrong and that the theory of the big hole and the achievable decoupling factor were correct. We have been commended in the American press for this feat in theoretical physics. I am not proud of it.

In the recent hearings before the Joint Atomic Energy Committee of Congress, Dr Teller recommended that we in the United States should continue determined research to find out further methods of decoupling, further methods of reducing the signal from an underground explosion. His argument is that we have to know all the possible methods of concealment if we are to develop a detection system which can deal with them. This may be so, but should we really spend our time and effort in drawing up a blueprint for a violator of the treaty, and also do the engineering development for him?

The Russians themselves have been quite consistent in their attitude toward decoupling. In

negotiations in Geneva for joint research on improvement of seismic detection, they refused, as recently as May of this year, to participate in any research on decoupling or to permit the United States to engage in such research. 'The Russian people', said Mr. Tsarapkin, the USSR delegate, 'will not understand it if research under the test ban treaty is conducted for the purpose of defeating the treaty.'

Because of the difficulties of detecting small nuclear tests underground, President Eisenhower on February 11 proposed to the two other great nuclear powers to effect, for the time being, only a partial test ban treaty. Tests in the atmosphere and underwater, as well as in the nearer parts of outer space, would be discontinued. He proposed to ban all large nuclear explosions underground, those giving a signal equivalent to twenty kilotons or more under Nevada conditions. Smaller explosions and decoupled tests would be permitted, because they cannot be identified by the present system.

Further, the President proposed, the three powers should start intensive research on the improvement of methods for detection and identification of underground explosions, so that in time the treaty could be extended to smaller underground explosions, and perhaps a complete ban could be effected in the end.

This proposal was accepted by the USSR on March 19 with an important modification; namely, that there should be a moratorium on smaller nuclear tests for a number of years. While only the large tests would be prohibited in the treaty itself, the three powers would declare in a separate document that they would refrain from carrying out nuclear explosions under twenty kilotons. The Russians proposed four to five years as the duration of such a moratorium; the West, two to three years.

To pursue this proposal further, the seismologists of the three nuclear powers met in May in Geneva to make plans for joint research on seismic detection. A large measure of agreement was achieved, but there is still a question as to the number and type of nuclear explosions to be used in this research.

Somehow, the seismic research has become identified in the mind of the public with the setting off of underground test explosions. This is by no means correct. The main problem is to improve the instruments of detection. This can be done largely by utilizing signals from earthquakes. Few explosions will be needed.

We need instruments which will give us more diversified information. We want to eliminate from the seismograms as far as possible the 'noise'; that is, the ever-present, minute, irregular motions of the earth. We need to learn to utilize calculating machines and mathematical tricks for the analysis of the records. We want to learn to deduce the shape and depth of the original earth displacement caused by a disturbance hundreds or thousands of miles distant from the recording instrument. At present, the depth can be deduced from the seismogram only if it is very great – about thirty miles or more. Perhaps we can learn to determine the depth of the source of the seismic signal to an accuracy of one mile. If this were possible, then signals originating from a depth of at least two miles could be attributed to earthquakes, because it is extremely difficult to drill holes that deep.

V

A number of promising ideas for improved detection were proposed in the spring of 1959 by the Berkner Panel, which was set up by the President's Science Advisory Committee to study the problem of detection of nuclear explosions. Some of these ideas were proposed to the Russians at the Technical Conference in November 1959. With a lot of research there is good hope for substantial improvement of the art of detection during a two- or three-year moratorium.

Would it be possible by these improvements to detect a decoupled test of a twenty-kiloton explosion in a big hole, using only the twenty seismic stations provided in the Geneva system? We do not know. It must be remembered that, with a decoupling factor of 300, a twenty-kiloton explosion looks like only seventy tons, not kilotons, and this is a very small explosion indeed. With the present methods, the Geneva system can only detect and locate explosions down to about seven hundred tons, not identify them.

But suppose it is impossible to improve the seismic techniques sufficiently by research. We already know one method which would certainly enable us to detect even the fully decoupled tests. This method is to make the spacing between stations much smaller. My proposal would be to decrease the spacing from 600 miles, as agreed to in the Geneva negotiations, to 120 miles in the seismic regions, and also in those regions where there are salt domes. In the parts of the Soviet Union where there are neither earthquakes nor salt domes, the stations could be distributed at a

much wider spacing – let us say, 250 miles. With such spacing, one would need about two hundred stations to cover the Soviet Union.

If the whole of the Soviet Union, seismic and aseismic regions alike, were to be covered by stations at 120-mile spacing, six hundred stations would be needed. I mentioned this number during the congressional hearings which were held in April 1960, under the chairmanship of Mr Holifield. The number was then quoted out of context and without the proper qualifications in sensational press reports which implied that I no longer supported a test ban treaty. This, of course, did not correspond to the intention of my testimony.

The twenty stations in the USSR which are provided by the Geneva system will be large, manned stations, each with about thirty technical people plus supporting personnel. They will have equipment to observe nuclear tests in the air as well as underground, and each station will have an array of a hundred seismographs in order to reduce the 'noise'.

The additional two hundred stations which I am proposing would be unmanned robot stations with one seismograph each, or possibly two. Such a system of robot stations would be simpler, cheaper, and, at the same time, more effective for seismic detection than the twenty large stations. I should think that these additional robot stations might well be acceptable to the Russians, especially if we do not demand them now but keep this idea in mind as a way out if no better method is discovered to observe decoupled tests.

How much would such a system of small stations cost? Two estimates have arrived independently at a figure of about $100,000 for each of these small stations. This includes provision for making the station 'tamperproof'. While one cannot expect such tamperproofing to be 100 per cent effective, one can expect to design the station in such a way that any tampering will be observable.

It is important to have reliable transmission of information from the robot stations to the large stations. Various methods of transmission have been considered by a group of communications experts. The total cost of the system of small stations in Russia, even with the most elaborate communication links, is estimated to be less than two hundred million dollars. Engineering estimates have also been made of the cost of the basic twenty-station net. No final figure has been given, but a total of half a billion for both the small and the large stations is probably the best conservative guess that can be made at present. This is not cheap, but it is a great deal less than the one to five billion dollars for the large stations alone which was mentioned in the Holifield hearings in April.

The system of robot stations is expected to detect and identify fully decoupled twenty-kiloton tests in the seismic regions. It is expected to detect and locate, but not identify, similar tests in the aseismic regions. I have previously shown that, once you get a signal, the number of inspections can be held within reasonable bounds. Of course, the robot stations would also greatly improve the detection of normal, not decoupled shots. It would be easy to detect and identify earthquakes down to one kiloton or less. Hence, the number of inspections could be greatly reduced.

It has been argued that several years will pass before we can build the system of small robot stations. This is true, but it would also take several years before a sufficiently large cavity could be constructed and successfully used.

In the meantime, there is a possibility of using already existing, smaller cavities in salt. There seem to exist, at least in the United States, several holes which would fully decouple an explosion of two or three kilotons. If similar cavities exist in Russia, it must be admitted that it would be possible to use these for testing very small weapons; there will always be a threshold of detection, even with the best detection system. The question is whether such testing would be worth while. Moreover, a two-kiloton hole could be used to achieve partial decoupling for a larger explosion – say, twenty kilotons. From the Louisiana experiments, one may estimate that this proportion of hole size to explosion energy will give decoupling by a factor of 30. The twenty-kiloton explosion then looks like two-thirds of a kiloton. This is just detectable by the Geneva net of stations, although without the robot stations a signal of this size could not be distinguished from an earthquake. Thus, with the Geneva net alone, it would be risky for a violator to attempt a partially decoupled explosion of twenty kilotons. A ten-kiloton explosion, partially decoupled in an existing two-kiloton hole, could probably go undetected until either we have robot stations or significant improvements have been made in the art of detection. However, it seems from the Louisiana experiments that the cavity will suffer damage when it is used for partial decoupling of an oversized explosion. It is, then, very doubtful whether

it could be used more than once. In this way, the few existing big holes would soon be used up.

I believe, therefore, that is is technically feasible to devise a system of detection stations and inspections which will give reasonable assurance against clandestine testing, with the possible exception of very small, decoupled tests.

VI

A key point in the monitoring system is on-site inspection. This was recognized as necessary in the Experts Conference of the summer of 1958. The Russians agreed reluctantly, but they did agree, to a passage which says that 'all events which are recorded by the control stations and which could be suspected of being nuclear explosions will have to be inspected on the site'. This passage, which our negotiators insisted on, has been a very powerful argument for our side. I am sure that the Russians have often regretted that they agreed to it. On the other hand, our delegation would not have agreed to the final report of the conference without this passage.

Estimates made in Washington have ranged as high as from one to three hundred necessary inspections per year in the Soviet Union for a complete test ban. Obviously, the Soviet Union wishes to prevent such a large number of inspections. Soviet negotiators have objected time and time again that we would use the on-site inspections for espionage purposes.

To solve this impasse, Prime Minister Macmillan, on his visit to Moscow in the spring of 1959, proposed that there should be a fixed quota of inspections every year in each country and that, in exchange, each side should have free choice of the inspections to be made on the territory of the other.

In other words, if a suspicious event is recorded on the seismographs in Russia, then the West, which means essentially the United States and Britain, would have the right to choose whether or not to inspect this event. They would decide on the basis of other knowledge whether it is reasonable in that particular locality to suspect a nuclear explosion. If, for example, the seismic event is shown to originate from a completely trackless wilderness in the mountains, then it may be presumed by the West that it was not a nuclear explosion. If, however, the seismic event is recorded in an abandoned mining area where one might very easily dig a tunnel to put in a nuclear bomb for testing, or especially in a salt dome area, then we would presumably insist on inspecting that area.

It seems to me that this idea of a quota, combined with free choice by the West of the events to be inspected in Russia, is a good compromise. Russia has accepted this idea in principle; our government has not: it insists on inspection of a percentage of the suspicious events rather than a fixed number. This implies that the number of inspections would be determined on the basis of technical need. The Russian position is that the quota must be determined on the basis of political acceptability alone.

In practice, however, the US government has adopted the quota idea as part of President Eisenhower's proposal of February 11, 1960, of a partial ban on nuclear tests. He proposed that this partial test ban be enforced by a quota of about twenty inspections per year in the USSR, a very reasonable number. The Russians, while accepting the February proposal with some modification, have not as yet responded to the proposed number of inspections. In fact, they have never officially mentioned any number and have given us to understand only that they are thinking of very small numbers of inspections. But one point is clear: The quota must be fixed by the negotiators before either Russia or the West will sign a treaty.

VII

Let us assume the most unlikely and worst possible case; let us assume that the Russians have gone to all the trouble of negotiating a treaty only in order to violate it. It would take them a very long time to set off any significant number of explosions; it would take a tremendous effort. It is generally agreed that they could test only small nuclear weapons. Even in the area of small nuclear weapons, a test series would take a number of years. Now, let us even assume that the Russians wish to go to all this trouble just to develop further small nuclear weapons. Where do we stand?

At this time, it is generally agreed that we are far ahead of Russia in the development of small nuclear weapons. We have nuclear weapons ranging from twenty kilotons down to a fraction of a kiloton. We have them in all different sizes. We have weapons which can be carried in big airplanes, in fighter planes, in ballistic missiles, in land-based rockets, and even in airborne rockets to bring down enemy planes. We have nuclear weapons which can be shot in short-range rockets,

like *Honest John;* we have nuclear weapons so small that they can be carried by the infantry with relative ease. We have an enormous arsenal of such weapons. The Russians also have a number of such weapons, but their arsenal in the field of small weapons, as far as we know, is much more limited than ours, and probably their weapons are not quite as sophisticated. It would take them a long time to catch up with us.

What is the alternative? Suppose we resume tests only in the area of small weapons. Then we could be sure that it would not take the Russians very long to reach our present, very high-level technology in this field. But, it will be argued by Dr Teller and his associates, in the meantime we also can make progress. Clearly, we could if we resumed nuclear tests. However, we have already gone far enough so that very little we can do in the future will be of great military significance.

While the Russians could gain considerably by the resumption of tests of small nuclear weapons, they also have enough such weapons to give them a sizeable capability in case of a tactical nuclear war. Therefore, they do not have a desperate need for improving their weapons, and thus not enough incentive for testing to risk a violation. Yet, if nuclear tests were resumed legally, the Russians would probably make more rapid progress than we would.

It has been claimed that we still have a long way to go in nuclear weapons. There are two schools of thought on this: one essentially represented by the Livermore Laboratory, the other by the Los Alamos Laboratory. The Los Alamos Laboratory, our chief laboratory in the development of nuclear weapons, which has to its credit most of the weapons which have been developed up till now, is generally of the opinion that not much more can be obtained in the way of weapons improvement. They will admit, and I will admit, that there can always be some further improvement, but the question is, is it worth while? Even if testing were allowed, would it be worth a great effort?

Let me repeat: If the Russians really want tactical nuclear weapons – that is, nuclear weapons of small yield – then the best thing for them to do would be to resume testing of such small weapons officially, exactly as was suggested in the original proposal by President Eisenhower on February 11. The fact that they asked instead for a moratorium on small tests indicates to me that they do not put much weight on development of these weapons.

I believe that if tests were resumed, if the negotiations on test cessation were to break down, then the Russians would choose to test big weapons, hydrogen weapons, in the megaton class. I think that these are the weapons which are most dangerous to us; these are the weapons which the Soviets consider to be of the greatest military importance to them. I want to remind you of the situation in the autumn of 1958. At that time the United States put in an extra test series, which is known as the Hardtack II series, carried out in Nevada. This test series consisted of a number of small nuclear explosions, from about twenty kilotons down to a fraction of a kiloton.

At the same time, the Russians tested the largest weapons they have ever tested, weapons of many megatons. They increased the yield from their weapons; they made them more efficient in the large-megaton class. They probably obtained in that test series the warhead for their big intercontinental ballistic missile. This is a tremendous weapon in their hands. If the Russians were to launch a determined attack on this country, perhaps a surprise attack, they would undoubtedly use these enormous weapons.

I believe that it was much to our disadvantage that the United States conducted the test series in the autumn of 1958. It would have been in our power to declare in August of 1958 that we would stop testing from that moment on. If President Eisenhower had made this bold declaration, I do not believe that the Russians would have conducted their test series in September and October. They used our small test series as a very welcome excuse to conduct their own. The bold political decision to stop tests altogether would have been much more to our military advantage, since such a decision would have made it difficult for the Russians to resume testing and to test their big warheads. Had the Russians tested nevertheless, we would still have been free to conduct the small Hardtack II series. We got comparatively little from our small test series; they got a great deal, and very big weapons, out of theirs.

If we were now to resume testing, if we were to break off negotiations in Geneva, then we could not force the Russians to test only small weapons underground. While we might restrict our own testing in this manner, the Russians could test anything that they considered to be to their military advantage. Whether their tests would be in the multimegaton category, or whether they would try to decrease the weight for, let us say, a

one-megaton weapon, I could not predict. But I strongly suspect that they would choose to test large weapons rather than small ones, that they would choose to test strategic weapons, which they consider the most important, rather than the tactical weapons which have had such prominence in public discussions in the United States.

VIII

If we had stopped nuclear testing when the Russians first suggested doing so, at the beginning of 1956, we would presumably have had a very great superiority in hydrogen bombs. We had tested at least half a dozen; they had tested one type only. We might possibly have a situation in which the Russians would not now have a hydrogen warhead for their ICBM. The missile gap has been a great worry to our military during the past two years. Without a hydrogen warhead, the ICBM would be much less important, and our superior position in planes might have remained of much greater significance.

The politically bold decision to accept the Russian offer to stop nuclear testing in 1956, either before or after our own 1956 test series, would then have given us considerable military advantage. Sometimes insistence on 100 per cent security actually impairs our security, while the bold decision – though at the time it seems to involve some risk – will give us more security in the long run.

There can be no doubt that, since 1956, the Russians have gained in nuclear weapons, relative to us. It is my belief that this is quite natural: the country that is behind will catch up; the country that is ahead will not make so much progress in the future. Dr Teller has pointed out that our nuclear weapons today are about a thousand times as efficient as they were in 1945. He states, 'In comparison with the nuclear weapons of 1960, those of 1950 appear completely obsolete. If the development should continue, there is no doubt that in 1970 nuclear explosives can be produced compared to which our present weapons will appear similarly outdated.' The first sentence is clearly true. But if we want to increase the efficiency of our nuclear weapons by another factor of about ten – not a thousand – from the presently achievable, we come to a point where the entire material in the weapon must undergo a nuclear reaction. Since there must be assembly mechanism, triggers, bomb cases, and the like, this is clearly impossible. Further nuclear weapons development will be limited by the laws of physics.

This being so, further testing by both sides would bring the Russian capability closer and closer to ours. If we stop nuclear testing now, we may reserve at least the little bit of military advantage in nuclear weapons that we still possess. It is certainly late enough. So I come to the conclusion that, even from the purely military point of view, for our purely military strength compared with Russia's, we would gain by a test cessation agreement.

The political gain would be enormous. Basic to the accepted control system of a test ban are the control stations on the territory of the contracting parties. If the agreement becomes reality, the Russians will for the first time permit foreign international inspectors to go on their soil, to have the right to check up on their activities. This is the first time that the Russians have been willing to give up any part of their sovereignty. Of course, we are asked to give up the same part of our sovereignty too, but for the Russians, with their extreme desire for secrecy, it is a far more difficult thing to do, and it would be a real achievement of the negotiations.

The Russians have further admitted that there should be on-site inspections of suspicious events detected by the physical control stations. This is another major concession. So, in the test cessation agreement, we would get the first admission in principle of the rights of a foreign control organ on Russian soil, an admission which might be of the utmost importance for further disarmament agreements. It would be very dangerous indeed for us to jeopardize this achievement by not concluding the test cessation agreement.

The main importance of our negotiations on the test cessation agreement comes, I believe, not from this agreement itself, important as it is, but from further agreements which must follow. It has been recognized widely in the United States, and also in the Soviet Union, that the continued arms race makes no sense. The two countries are fully capable of destroying each other, in fact, of destroying each other several times over. This is an absurdity. Modern war simply does not make sense as an instrument of national policy. I believe that we should try to arrive at a situation of carefully controlled limitation of armaments. It is a difficult thing to achieve, and it will be a long road before we do.

However, if we want to stop the armaments race, then we have to make a start somewhere. It has to be made in a way consistent with United States policy, meaning that every limitation of armaments must be carefully controlled. We have to make a start in an area where it does not cost us too much, where we can back off again if the first treaty doesn't work. With the test cessation agreement, this would be possible, because it covers a sufficiently restricted subject.

I have so far discussed this problem entirely in regard to the two powers, the United States and Russia. However, the effect on other powers is at least equally important. It is clear that other powers may also get nuclear weapons soon. In fact, if we wait long enough, they surely will do so. I do not know how long it will take China to achieve this capability. I do not think it will be next year, but I will not be surprised if the Chinese develop nuclear weapons before another five years pass. It is to our interest to keep nuclear weapons out of China's possession. We have every interest in restricting the nuclear club to its present members, essentially three, with France a junior partner. If the three great nuclear powers continue nuclear testing, then there will be no pressure on the other countries to refrain from developing nuclear weapons. If, however, the three great powers give up nuclear testing, and give it up completely, then popular pressure, both from the great powers and from the small powers, will be very strong on the other countries to make them adhere to the treaty which the great powers have signed.

I cannot predict whether China will in fact adhere to a test cessation treaty. I think that both Russia and the United States would desire that China do so. But one thing seems to me certain: If we do not have a treaty on cessation of nuclear tests, then China will surely get nuclear weapons in a fairly short time. For this reason, it is imperative not only to have a treaty but to have it soon.

At this time we can still get something if we agree to stop nuclear testing. But we have a wasting asset here. Before long, I believe, public opinion in the world will force us to stop nuclear testing without our getting anything in exchange. At present we get in exchange recognition by Russia of stations on Russian soil and of the principle of controlled disarmament. We may further get in exchange the restriction of the nuclear club to three members.

Opponents of the test cessation agreement want to have a perfect agreement; they want to have an agreement in which we can be sure to detect each and every violation, no matter how small. I think that by insisting on perfection we shall end up with nothing.

The Fear of a Test Ban Evasion

DAVID R. INGLIS

From The Bulletin of Atomic Scientists
May, 1960

This article expands the argument of the last, and deals in particular with the revived hypothesis that 'clean' fusion weapons could be produced if nuclear testing were to be permitted again.
Dr Inglis is the Chairman of The Federation of American Scientists
(By permission of *The Bulletin of Atomic Scientists*)

THE CONTROL of nuclear arms development through a world-wide monitored test ban is becoming an increasingly prominent objective of US foreign policy. Both the US and the USSR seem to be recognizing that an agreement which would prevent the spread of nuclear weapons will offer both countries a gain in stability. There will be other such gains. With a test ban in force, national leaders may begin to feel less desperate about the otherwise endless spiral of the arms race; the temptation to plan a surprise attack may thus be reduced; with general relaxation of tensions and with the experience gained in a test ban, arms limitation measures requiring more detailed inspection and greater reliance on international institutions may become possible. It is only then, and not just as a result of a test ban, that we should look for substantial economies in defence expenditures. A controlled test cessation will also reassure the world that the atmosphere's burden of radioactivity is not being increased.

Development and Detection

There is, of course, a division of opinion on the test ban question within our government and among the public, and probably also within the Soviet government. Some fear that limitations placed on our weapons development will not be compensated by the limitations placed on the weapons of the other side. Some of the people who have this fear are obsessed with a myopic concentration on our own development objectives of the moment, for example, on the weapons on the drawing board which will need to be tested to be useful. These people fail to recognize that the other side has similar plans which will be similarly frustrated by a controlled agreement to stop tests. This view is unfounded if the test ban is effective: the Soviets probably have more to learn from future tests than we do. They increased the size of their largest tested weapon from something like three megatons to fifteen megatons (about as big as our biggest) in the last three years, while we made no such increase. This happened after we rejected a Soviet offer to stop testing if we would.

The more serious fear concerns those categories of weapons for which evasion of the control agreement would be possible. There is some debate over what size tests might go undetected, but most people are agreed that with the detection network now contemplated, undergound detonations roughly one ten-thousandth as powerful as the biggest H-bomb might occur without much risk of detection, if there were sufficient incentive to undertake them. In the larger categories, such as a warhead for the *Polaris* missile, our inconvenience is presumably compensated by a Soviet inconvenience, since in this range underground test evasions are not possible.

The principal concern is then small tests of tactical atomic weapons for battlefield use. In addition to weapons intended to produce blast damage in the low-kiloton and sub-kiloton range, the weapons in prospect are said to include some of very low yield whose main function will be to kill by neutron irradiation (after a delay during which the victim would presumably be an ideal *kamikaze!*). To assess the possible value of progress in such weapons, we must estimate their likely importance in the present and future world situation.

Small Weapons or Large?

We have already practically deprived our armed forces of the capability of fighting a non-nuclear 'brushfire' war by our commitment to tactical nuclear weapons. One might say that there is no

use arguing any longer about this commitment. The opposing arguments which made this a difficult decision are still valid, and while we must now implement the chosen policy, further refinement of this type of warfare may represent only limited gains. The main argument for tactical nuclear weapons is that an army in the field must have the most modern firepower, and that this is particularly true of the numerically inferior side. The main argument against reliance on these weapons is that a small nuclear war probably cannot be prevented from growing into a big one – the war that nobody wants. There is a sharp distinction between conventional weapons and small nuclear weapons, easily recognizable by radiation properties, but no such distinction exists between different sizes of nuclear weapons. One can imagine a small nuclear war remaining within limits for the 'first few rounds', with only a few villages and towns in the fighting area destroyed. But it is hard to believe that when one side will start losing, it would not unleash its largest weapons. In this age of the 'great deterrent', the principal purpose of tactical forces of any kind is to reduce the dangerous dependence on the great deterrent. It is desirable to be in a position to 'put out brushfires', or to prevent them from starting through a limited threat, without threatening the end of civilization. In such situations the great deterrent is too great to be plausible; a threat to use it may be recognized as a bluff, or mistaken for one. However, tactical nuclear weapons also may be 'too big' for use in 'brushfires', or even as a threat to prevent small outbreaks, because both sides are aware of the danger of a big nuclear war developing from their use.

We have been led to believe that we are ahead of the Soviet Union in small nuclear weapons capabilities. If the Russians should make some refinement by clandestine testing, this would help them in trying to catch up to us. Militarily undesirable though this may be, it is not the sort of thing that would upset the balance of deterrence. In the very small sizes that might escape detection, it is probably not even important enough to provide a strong incentive to run the risk of being caught at evasion. Thus evasion is not very likely to occur and would not be very harmful if it should.

A Radical New Weapon?

Scientists concerned with the control of weapons development have speculated that a control arrangement might be upset by the unexpected discovery of a drastically new principle on which more effective weapons might be based. With fission and fusion making use of the properties of heavy and light elements among all the materials at hand, whose gross stability properties by now are very well known, there seems to be no room for drastic surprises in the nuclear weapons field, although there is room for gradual improvement. The fusion reaction in the H-bomb was quite difficult to attain even with the enormous help of the powerful fission process. That it could have been done without this help has seemed an extremely remote possibility. It seemed clear that if it could be done at all it would need a very large and awkward device to concentrate the energy from a large body of chemical explosive into a small space, and that unless it were easy to do in this way, it would probably never be done in a small and handy weapon.

Perhaps the first indication of active interest in fission-free fusion was revealed in the official mention of the 'hundred per cent clean bomb' in June, 1957. At the time the London Disarmament Conference was beginning to look rather hopeful, until the then chairman of the AEC purposefully and dramatically released the information about our plans to develop 'clean H-bombs'. These 'clean bombs' are less clean than the name suggests, because they use a fission booster.

It is understandable – but most unfortunate – that in our democracy military secrecy hides certain information needed to strengthen our political judgment. It is even more unfortunate that sudden releases of information, or veiled hints about the existence of such information, can sometimes effectively freeze political judgment and make political action difficult. Professor F. J. Dyson, of the Institute for Advanced Study and recently with General Atomics, writing in the April issue of *Foreign Affairs*, revealed official interest in the possibility of fission-free fusion bombs, in a manner that might tend to have such an effect.[1]

The fact that as able a physicist and mathematician as Professor Dyson is interested suggests that it would be a mistake to dismiss the project as a dream completely impossible of fulfilment. However, a faint glimmer of hope may be enough to keep such a long-range project going, even as hope for ultimate success in achieving industrial fusion power in some future decade provides a

1 "Future Development of Nuclear Weapons," *Foreign Affairs*, April 1960.

great deal of patient enthusiasm over 'Project Sherwood'.

Several years ago there were enthusiastic predictions, since retracted, that this project would meet with early success. To quote from an article of the time,[1] 'Only the more optimistic physicists believe that a successful [controlled] fusion experiment may be achieved within four or five years. One of the world's most eminent theoreticians believes that the odds against success in this period lie somewhere between 10,000 and one million to one. He is, however, not engaged in the effort to tame fusion, and to those who are, his pessimism seems to reflect a deplorable lack of faith in human ingenuity. "The scientific optimists", says one of them, aged twenty-nine, "almost always win out".' The eminent outsider seems to have been right.

How Can We Judge?

It would be a great mistake to hobble our efforts toward the development of international agreements intended to stabilize world peace because of technical dreams with only a small likelihood of fulfilment – dreams which, even if fulfilled, would not be crucial for world stability. It would be another mistake to permit our views of national policy to depend on the judgment of the few eminent scientists who have dedicated themselves to the progress of weapons and are familiar with the current technical situation in this field, but who are permitted to tell us nothing about the technical basis of their political judgment. Rather we must judge the technical situation to the best of our own ability on the basis of known general principles and, taking into consideration the technical hints we have received, arrive at our own political conclusions. I must make it clear that these judgments are personal and are made on the basis of widely known principles. I do not have access to classified weapons information.

Dyson takes care to make only two technical statements about the possibility of fission-free fusion bombs. The first is that 'there seems to be no law of nature forbidding the construction of fission-free bombs. The question remains whether this theoretical possibility is likely soon to be realized'. His second statement is a 1958 quotation of a Soviet physicist, Artsimovitch, stating that in 1952 neutrons were observed as a result of the high temperature produced by chemical explosive surrounding heavy hydrogen. These statements, so far as we know, are entirely true. They do not say that there is any practical likelihood that fission-free bombs will be produced in the foreseeable future, and in regard to this question each of these statements is utterly trivial. They create an aura of scientific objectivity, and in the context of the political remarks in which they are imbedded, they are easily taken to say what they do not say. They have been interpreted by *Time* magazine thus: 'The big powers are on the brink of developing radically new generations of cheaper, lighter, militarily more useful weapons'. There is no technical basis for this statement, and it is almost certainly a complete falsehood. This dangerous falsehood can be attributed to no one individual, but to a failure of communication between two different types of individuals. The reference to the Soviet neutron experiment in 1952 is probably Dyson's discreet way of saying that we have achieved the same thing, perhaps even earlier. We must then clearly assess the meaning of neutron production for the production of a practical regenerative release of nuclear energy. Neutron production does not mean that practical success is just around the corner, any more than it does in Project Sherwood, where it has recently been emphatically claimed that thermonuclear neutrons have also been produced.

The date, 1952, when the Soviets claim to have achieved the release of neutrons by means of a chemical explosive, is in itself a hint. This was the year before their first detonation of a 'thermonuclear device', precursor of their H-bomb, and they were doubtless very busy carrying out experiments for the development of that weapon. One such experiment would have been to determine how high a temperature one could attain by focusing shock waves in chemical explosives. If the temperature was high enough to make deuterium give out neutrons, this fact could have been used to calculate whether, with a fission explosive as a booster, the much higher temperatures (at sufficient densities) could be obtained necessary to make the deuterium or other light elements ignite in fusion. Thus the neutrons from chemical-explosive compression would act as a sort of thermometer part way up on the temperature scale.

The very great importance of the fission booster in this process is suggested by the fact that fission gives out a hundred million times as much energy as does a chemical explosive per atom (or still more than a million times as much on a weight basis). It was no simple task to design the H-bomb,

[1] "Fusion Power: The Trail Gets Hotter," by Francis Bello, *Fortune*, July 1957, page 135.

even with a fission trigger, and great cleverness was required. The direct-fusion project is trying to do the same thing without the factor of one hundred million to help in going the rest of the way up the temperature scale. This is a measure of how enormously more difficult the project is than was the H-bomb project.

For a thermonuclear explosion to occur at the focus of a shock wave within a chemical explosive, it is necessary that large numbers of heavy hydrogen atoms collide at energies high enough to 'fuse'. The energy released by this fusion would then accelerate other atoms so that they in turn would fuse upon collision, and so on for many generations, all within a period of time brief enough to prevent the atoms from flying apart. To succeed in observing neutrons requires only that a few of the first atoms heated by the chemical explosive should give off neutrons (there being no neutron background to confuse the observation, as there would be with a fission explosion). The demands in this experiment are so small compared with those for a fusion explosion, that neutron production is no indication at all of the possibility of a fission-free bomb. The fact that simple neutron production was apparently quite difficult to achieve is, on the contrary, further indication of the virtual impossibility of ever making a practical fusion weapon without the help of the multi-million-fold boost from the fission process.

Since Dyson chose to tell about a single bit of evidence of such trivial technical progress, as he must appreciate, we are left completely dependent on his simple word that he considers the fission-free fusion possibility relevant to diplomacy. We must then try to analyse what this word might mean, and why a man of his high intellectual acumen and integrity should have soberly submitted such trivial and potentially misleading evidence.

The closing words of his article are: 'Apart from all considerations of patriotism, it would be wrong for us to leave the future development of nuclear weapons to chance. Our development and possession of these weapons will help to maintain the stability of the world, until in the fullness of time we can hand over all such devilish inventions to an international authority powerful enough to prevent their abuse'.

With his analytical mind accustomed to abstract reasoning he seems to simplify the possible conditions for stability of the world into two absolutes, the arms-race world with unlimited competition as an admittedly precarious and temporary basis of stability, and the international-authority world as a final and necessary goal. Between the two he admits no compromise but demands a sudden transition in a future flash of universal enlightenment. He fails to recognize that in the political world, even more than in our beloved world of physics and mathematics, concepts evolve and become accepted in a gradual, step-by-step process. He thus seems to see as bad any compromise with absolutes, any introduction of practical gradualism into the arms-race world with which we are stuck in this definitely pre-Utopian decade. In his world of absolutes, he asks whether fission-free fusion is absolutely impossible or possible; the answer is 'possible'. He then sees fit to warn us about this.

He seems to chafe at the closed doors when he uses the old dodge of quoting a statement from the 'other side' to convey as nearly as possible what he wants to say. With such limited means of communication at his disposal, it might better have remained unsaid, for the result was misleading.

Another possible interpretation is that he considered the technical statement impressive to a non-technical reader and was sufficiently interested in backing up his political conclusions to risk being misleading on the technical side.

Practical or Remote?

A precedent for such confusing overzealousness has been set when at least one other extremely capable scientist (with a similar devotion to a similar political philosophy, and with the help of similar selective amplification by the mass-circulation media) has on occasion eloquently expounded the virtues of Project Plowshare as an argument against stopping tests. Here there is no secrecy behind which to hide, and the technical basis for the argument is available to all. This project includes some fairly interesting investigations of non-military applications of atomic explosives, but the need to pursue them unilaterally very soon is utterly trivial compared with the urgent need for international arrangements to reduce the likelihood of war.

One cannot be completely sure that fission-free fusion is absolutely impossible, for the wild blue yonder of science is very difficult to anticipate. In this unsafe world where mass annihilation and the end of our civilization seem much more likely than a fission-free field weapon in the next ten or twenty

years, and where political advantages must be balanced against technical risks, it is most important to distinguish carefully between likely practical developments and remote scientific possibilities.

Just on the off chance that the very unlikely should be true, and that there should be some genuinely promising evidence behind closed doors which in this instance hasn't 'leaked', then we may trust that officials would be informed who could modify our test ban proposals accordingly. But in this judgment behind closed doors, the utmost restraint is necessary, lest there be failure of communication leading to such false claims as the one quoted above. Unless the investigators can give some very practical evidence of progress, for example, that they have achieved a thermonuclear yield of energy at least a tenth as great as the chemical energy put in, their claims should not be allowed to influence a test ban proposal, and even in that case only in detail. It seems very nearly certain that such a challenge could not be met, and that no officials have any such reason for reticence. One bit of supporting evidence is Dyson's feeling it necessary to bring the matter before the public, even though inadequately and by means of such confusing data.

If success in achieving fusion-free bombs were indeed likely, the many-nuclear-nation problem would be greatly complicated by this way of bypassing the need for producing fissionable materials, and the political approach to this problem should be modified accordingly.

Between the present nuclear powers, fission-free weapons would have only marginal value in large sizes, making the difference between a so-called 'clean' bomb and one that is more nearly clean, probably at the expense of bulkiness. In small sizes, it would be useful as cheap and thus perhaps abundant battlefield ammunition. In this category, our present 'nuclear plenty' of fission bombs is probably ample for any action intended to defend a region locally without completely destroying it. Only if fission-free bombs could be made in small sizes without evolving through the large sizes, could they be developed by a series of clandestine tests which could evade a ban.

The tiny chance that these weapons could be developed seems much too remote to contend seriously with the many good reasons for seeking effective agreement on a test ban with a practical degree of control. But even if the Soviet Union, by evasion of the test ban, suddenly should come up with a large numerical superiority in small nuclear field weapons, their gain would be in that dubious category which we have characterized above as too large to be plausible for use on 'brushfires', because they are too clearly a member of the family of nuclear weapons to be used without fear of provoking the use of the ultimate 'great deterrent'.

That this development would take place seems unlikely in the extreme, yet even if it should it would not be expected to upset the balance of deterrence between the great powers. The very small risk here involved should be far more than offset by the stabilizing effect of evolving arms control. Therein lies the more hopeful way to reduce our dependence on the great deterrent.

Science and non-scientist citizens alike find it difficult enough, even with the best of information, to assess the gains inherent in test ban agreement, the prospects for improved controls, and the risks of technically plausible types of evasion, in a rational perspective in relation to the precarious world situation. They should be spared the confusion of nuclear phantasmagoria and trivia.

Expansion of the Atomic Club

Lieutenant-Colonel F. O. MIKSCHE

From Aussenpolitik

May 1960

Here one of France's leading military commentators puts forward a view that is gaining ground in France and in the other continental European NATO countries. The dilemma of control over nuclear weapons in NATO, and the possibility that fresh nuclear powers will arise, should be solved by a deliberate policy of creating national deterrents throughout the Alliance
(By permission of *Aussenpolitik*)

PRESIDENT EISENHOWER'S statement on a possible alteration of the Atomic Energy Act of 1954 seemed to be the first step towards terminating a situation which is becoming steadily more untenable, partly because France's entry into the Atomic Club can no longer be avoided and other nations will follow sooner or later. The real issue here can best be explained from recent history, which makes it necessary to take a backward look. When the Atlantic Treaty was signed, the plan was to base the defence of Europe on conventional forces with the American atomic weapons simply serving as a cover. However, the less enthusiasm the European countries showed for filling their armaments quota in the conventional field, the more the defence system of the West had to be concentrated on the nuclear deterrent. This development reached its peak in 1955, when the so-called tactical atomic weapon was built into the structure of standard military equipment. Nuclear fire-power – it was said – was to counterbalance the overwhelming manpower potential of the East. This, however, created a defence system which could only react atomically to even the most minor conflicts, and this was of grave political consequence.

It has since become a matter of doubt whether, despite all the statements and assurances, an atomic war could be conducted in a limited field, and whether the use of even small nuclear explosives would not release a chain reaction which would probably result in total atomic war. Nobody today would be in a position to prove the opposite. This being so, a policy based on such an unstable strategy is far too insecure to be really relied upon. In any case, the problem of limited or total atomic war is also dependent on the strategic situation in the world. For the Americans, living on the far shores of the Atlantic, even Europe as a whole would be basically only a 'tactical sphere of operations', whereas for us in a European country, merely the use of 10 'small' Hiroshima bombs would be equivalent to a full 'strategic eradication'.

To defend Europe with atomic weapons would amount to the downfall of our culture – in other words the destruction of the very thing we want to preserve. A catastrophic strategy of this nature would not contribute in any way to the solution of those problems which are the causes of possible conflict. It therefore follows that statements claiming that atomic reprisal would be unavoidable, even in the event of an attack with conventional forces, can hardly be justified. It is as if one were to say: 'If you attack me, then we'll both be blown sky-high'. This sort of planning is quite incompatible with a realistic policy. It is a crass negation of all the rules of classic strategy.

The following points emerge:

1. Atomic weapons, as long as they were in the possession of one power, constituted the most dangerous aggressive weapons of all time.

2. The fact that several powers have these weapons at their disposal today, paralyses their potential usefulness.

3. They have therefore ceased to be offensive weapons. The danger of the inevitable reprisal also excludes their use as defensive weapons, except in a case where the attack is made with them.

4. Their importance lies only in deterring the opponent from using them.

5. For this purpose, however, the possession of atomic weapons is not essential. Their presence is enough.

6. They cannot, however, be the basis on which a military policy is founded, but can only complement the conventional forces, giving them atomic cover. For this purpose, however, they are essential.

The slogan 'There is no alternative to peace'

also leads to false conclusions, for the belief that there could be no other wars apart from atomic wars is just as naive as the now popular idea of competitive co-existence. Despite the danger to which mankind is exposed by the most terrible weapons of destruction of all time, their mere existence will hardly be able to contain the passions which move the world today. Fanatical nationalism, ideological conflicts, the struggle for markets and raw materials, are the characteristics of the world picture. 'There is no alternative to peace' may be true, merely for those who can still think and act only in terms of atomic strategy because they have no other means at their disposal but the most powerful. Is it not conceivable that, while the atomic potential of the great powers mutually cancels out, less risky methods might be sought under this 'protective umbrella' in order to achieve the aims of a policy? Is it not likely that the existence of atomic weapons will create new forms of warfare? Pity him who has only these weapons at his disposal and is therefore constantly faced with the dilemma of either risking all or simply giving in. And pity him who has none and is therefore exposed to blackmail by the atomic powers.

The great deficiencies of a defence based *only* on atomic weapons are obvious. It is not easy to understand the logic of those who think that any war would necessarily begin with a sudden atomic coup, the fury of which would eliminate the opponents' means of reprisal. Apart from the vital question as to whether it is possible to count on achieving total paralysis, and even assuming that this were really so, the more vulnerable West would be harder hit by it than the East. But what if the Atlantic powers persist in their passive defence and it is the Russians who open the hostilities, with an all-annihilating Pearl Harbour? Or what would happen if, for safety's sake, the West used only tactical atomic weapons, while in reprisal the Russians struck back, omitting intermediate stages, against the nerve centres of the West with guided missiles? According to our own theories, the Atlantic powers would then hardly be in a position to return the enemy's blow. It follows logically that in an atomic war, survival would be possible only to the side which attacked preventively, which is just what the West – as we are constantly being assured – will never do and the Russians are presumably not contemplating, either.

Atomic war is a rigid form of warfare, conducted with over-powerful weapons. The total destruction of all the important cities and industrial centres of the enemy, the complete crippling of his vital functions within a few days, is more conceivable than the removal of his whole reprisal potential. The latter would necessitate the destruction of hundreds of airfields and missile bases within a few hours, which would be extremely difficult, since their sites are for the most part unknown to us. It is of course undoubtedly true that the crippling effect of an atomic attack would be all the greater according to the degree of surprise achieved.

The absolute character of atomic warfare demands an absolute decision. How is this to be taken? Who could possibly feel justified in gambling the existence of a whole civilization, in the name of the people, on a card whose chances of winning or losing no one can estimate? What political situation could justify such a step? The answer to these questions – the question whether it is possible at all to answer them – is of decisive importance. For besides the purely technical and strategic limitations, which have a restrictive influence on the use of atomic weapons, the psychological and political ones are perhaps still more significant. Both groups of questions – technical and strategic on the one hand, psychological and political on the other – constitute two aspects of the same problem, which are closely interrelated and consequently inseparable.

* * *

The Atlantic Treaty was concluded only to deal with military aggression against the territories of the member nations and not to protect their general interests. It became steadily clearer, however, that in Moscow nobody was seriously thinking of a straightforward attack. After the Soviet Union itself became an atomic power and consequently cancelled out the Western atomic potential, the NATO theory of deterrence became invalid. What was left was a mutual deterrent which was still limited to the atomic field and left the Russians plenty of scope for political manoeuvre in other fields. Thus in about 1956 they transferred the main weight of their activities to areas outside Europe, particularly the Near East and Africa. Their aim is to defeat the West through indirect strategy by means of subversive warfare, in other words, politically rather than militarily. Against this threat, the defence system of the Atlantic Treaty, based only on atomic weapons, is politically impractical because the enemy can

at all times choose the objectives of his policy in such a way that, taken individually, they would not justify the unleashing of an atomic war. All this has contributed decisively to the weakening of the alliance.

Since the West has developed a rigid strategy, it has little room for political manoeuvre. From this situation it also follows that the non-atomic countries are filled with suspicion, since they are not unjustifiably afraid that they may be left in the lurch by the atomic powers, especially in instances which concern interests in areas outside the Atlantic Treaty. On the other hand, Western European nations which have no direct interests outside Europe are afraid of being lightly involved in conflict by one of the world powers, that is, over disputes which have nothing to do with them. In general, it has become extremely doubtful whether an atomic power would ever run the risk of exposing itself on behalf of a non-atomic power and this is of course well known in Moscow.

Even the expansion of Atlantic solidarity to other areas of the world could bring about little change in this state of affairs unless there were some willingness to increase the conventional forces to the extent which would be necessary in order to regain independence from atomic weapons. However, there is little inclination towards either of these alternatives. In any case, all the plans and assurances in relation to atomic defence by other powers, or the redoubled control of American nuclear explosives stocked on foreign territory, are untenable provisional measures of doubtful value which are in fact already out of date. However one looks at the problem, one inevitably comes up against the complex question of authority. Who, in the last analysis, is to give the order? And how is it to be carried out?

Real control can belong only to the actual possessor of these weapons, who is at the same time master of the bases which are necessary for their use. The Anglo-Saxons do of course possess these weapons, but they are not always the owners of the areas from which they could be effectively used. These difficulties could not be removed either by the creation of a European deterrent, or by one which was directly under NATO. In the first case, a Europen authority with sovereign powers would have to be created. In the second, it is difficult to assume that the 15 member nations of the Atlantic Treaty – just for lack of a central authority – would be prepared to use atomic weapons in defence of the interests of one or more of the Allies. Even the most vivid imagination fails to convince one that Belgium would allow herself to be involved in an atomic war on behalf of Greece, or Portugal on behalf of Norway. There remains the third way, the general distribution of atomic weapons, a road which leads us into the unknown. But just because this is so, an attempt to deal with this extremely complicated question might be rewarding.

The argument that the expansion of the Atomic Club might increase the risk of atomic conflicts is convincing, and will hardly be called in question. Like any other argument, however, it has an obverse side and it would be foolish to put on blinkers instead of facing this problem honestly. This much is certain:

1. Although it may now be impossible to conduct an independent policy without being covered at the highest level by the atomic *ultima ratio*, it is at the same time hardly possible to maintain potential flexibility when one is relying solely on the rigid atomic strategy.

2. Since others can hardly be expected to expose themselves to the risk of atomic reprisals in the defence of foreign interests, a unified position can hardly be anticipated from the Western powers in questions of large-scale policy. The possession of atomic weapons has therefore become essential. Anyone who does not possess them loses his freedom of action and is delivered up to the incalculable reactions of the atomic powers.

3. In contrast to the present view, one could equally well assume that in certain circumstances the expansion of the Atomic Club would act as a deterrent to war, as a result of the even distribution and deeper meshing of the mutual neutralization. The deterrent effect undoubtedly gains in credibility as soon as one power is in a position to use his own weapons in the defence of his own interests. This in certain circumstances might increase the flexibility of the Atlantic Treaty.

By easing the present situation, in which everyone is too dependent on everyone else, not all the 15 Allies would be faced at once with the agonizing alternative of risking everything or simply giving way, but on the other hand the individual states would be given far greater scope. By thus dividing the problem into its component parts, the other treaty members, without directly exposing themselves, could act indirectly in the background. This would mean removing a great deal of the burden from the present atomic powers, while at the same time this very distribution of risks would

considerably limit the political scope of the adversary. This is the vital point! Naturally there would be no question of doing without conventional forces even in the future, since the problems simply shift in scale without altering in essence. In order to maintain their political mobility in detail as well, the individual states would have to continue to be capable of graduated military action.

We will now try to explain things more clearly by taking an imaginary example. Let us assume that somewhere in the wilds of Kurdestan a revolt breaks out, the strings of which are being pulled by Moscow, and that in defence of vital interests the Turks are forced to march on a territory outside the area of the Atlantic Treaty. According to the Soviet concept of law this will naturally be interpreted as 'aggression against a small nation fighting for its freedom and independence'. As the 'natural protector of small nations' the Soviet Union can hardly remain a passive onlooker. And in order to apply pressure on Ankara, Soviet divisions are concentrated in the Caucasus, backed up by the atomic threat. The Turks reply along the length of their northern frontier with a similar concentration of their conventional forces, but they do not possess atomic weapons. It would be impossible to expect the Americans to intervene with atomic weapons on Turkey's behalf under such legally obscure conditions and over a conflict of this nature. This is naturally also recognized in Moscow, hence the great scope of Soviet policy and the compulsion on the Turks to give in.

The problem would appear in quite another political light, however, if the Turks were in a position to offer a deterrent of as few as ten Hiroshima bombs, which would be the more credible since in this case atomic weapons would be serving the protection of national interests. The tables would to some extent be turned, since it would now be the Russians who – like the Americans today – would be constantly exposed to undesirable risks, out of all proportion to the value of the object of the struggle. In this way the Soviet atomic threat would be deprived of conviction, since a few Kurdish villages would certainly not be valuable enough to Moscow to risk exposing Baku, Tiflis, Odessa or Stalingrad to atomic destruction for their sake. This example is no more valid than examples in general, and was simply proposed to give a concrete form to the argument. One can easily conceive of similar situations in other countries.

The current argument that the expansion of the Atomic Club would promote the political isolationism of individual countries is similarly relative. The visible weakening of the Atlantic Pact can to a great extent be imputed to mutual distruct, of which the deeper cause is the atomic problem. The more the gulf widens, the greater becomes the urge of the non-atomic countries to be responsible for their own safety. Who can guess what might be happening in 10 years' time in a world in the full flood of change? An atomic arsenal cannot be spirited into existence from one day to the next. It is hardly surprising then, if some people are anxious to avoid being overtaken by new atomic powers.

The expansion of the Atomic Club is inevitable because it lies in the line of a natural development which cannot be halted. It cannot really be possible to try to prevent this by withholding from allies technical information which has been known to the political adversary for years, and thus forcing allies to invest enormous sums in research in order to discover something that has long been known. It would be enough if, of the 20,000 bombs which the United States are said to possess, they were to release 150 Hiroshima bombs, with right of disposal, to their Allies (according to importance and position). However, if this problem is not satisfactorily solved in one way or another in the near future, it is to be feared that the atomic explosion itself will blow up the Atlantic Treaty.

Since atomic weapons are absolute, no atomic balance is possible, owing to the saturation of destructive power in the purely material sense. It follows that it is inessential, beyond a certain – not easily defined – point, to possess more or stronger 'strategic explosives' than the rest, in order to be accounted an atomic power in the political sense; it may be added that in the political sense – because of the indivisibility of atomic war – tactical atomic weapons are not absolutely essential. The strategic position of certain nations is also significant – their distance from the probable adversary. In the case of Turkey, for instance, an atomic range of 1,000 miles would be a sufficient deterrent. It is certain that the gradual expansion of the Atomic Club would entail a shift in the weights of power politics. The result would be an inevitable and far-reaching equalization between great and small, in other words a completely new structure of power relationships. These considerations, besides the anxiety to keep the danger of an

atomic war within bounds, also determine the current policy of the atomic powers in maintaining their monopoly as far as possible.

The idea that the Americans should distribute atomic weapons may sound surprising at first. But how does the problem appear on a closer look? Practically speaking, many countries today could manufacture atomic weapons if they could produce the necessary finances. It is estimated that within the next five years there will be five European atomic powers and that within twenty years the coloured peoples will also possess these weapons. The distribution of nuclear explosives would in any case have the advantage that the present atomic powers would at least retain control of production, since everyone is chary of undertaking the indispensable gigantic investments. If they do not do this – as is probable – then the present atomic powers will lose on both counts, i.e. will control neither production nor use of the weapon.

Assertions that, if atomic secrets were entrusted to the French or others, Moscow might equally share their secrets with Red China, are nonsense, since there is no possible connection between the two eventualities. But apart from this, the Russians, who are busy settling their disarmed soldiers down as a militia in Siberia, would certainly take good care not to arm a dangerous neighbour against themselves. Equally primitive is the argument that the expansion of the Western Atomic Club might cause the Russians to arm their European satellites with atomic weapons, or the argument that on the contrary, as many people assert, they could not allow themselves to do this because they do not trust them. There are enough Communists in each of the European satellite countries to use a few atomic weapons according to Soviet orders. The fact is that the satellite governments (in contrast to the people) are much too servile to have the least idea of demanding atomic weapons and right of disposal or to make their membership of the Warsaw Pact dependent on the fulfilment of this requirement, as might happen in the West. In any case, the Russians would have ample opportunity to give their satellites atomic weapons and still keep them under absolute control, so that the relationship of the latter to the West would hardly be altered. But Moscow would in fact have backed the wrong horse, since the present Western atomic powers would then be forced to do the same for their Allies, which would inevitably have the effect of narrowing the scope of Soviet policy. Thus the expansion of the Atomic Club within the Eastern bloc would result in a far more unfavourable situation for Moscow than for the West.

Something far more dangerous may happen, regardless of whether the Western atomic powers agree to the expansion of the Atomic Club or not. Should it be in their interest, the Russians would be in a position to make any given country which has a quarrel with the West (e.g. Siam, Afghanistan, or Iraq) into an atomic power within a short time by providing a few bombs. This could easily be done under the camouflage of international arms profiteers, the servicing of the weapons being entrusted to Soviet engineers.

The Americans have bound their hands in advance by the MacMahon Act, while the Russians' hands are free. The latter have the great advantage of being free to trade in atomic explosives within the obligations of international law, just as much as in any other weapon. The Americans could do so only after a complicated Congressional procedure. In accordance with their laws, any use of atomic weapons must take place in the presence of official representatives and this necessitates the authority of the President, which makes it politically far more compromising. Undoubtedly the delivery of atomic weapons is not conceivable in the Soviet Union either, without the permission of the government, but the difference lies in the fact that they are not bound by laws in this respect, which is politically of great importance.

The arguments put forward in this essay undoubtedly also have their obverse side, but everything is relative, and for the sake of certain advantages one is always obliged to incur certain disadvantages. The deciding factor in such problems is to determine where the preponderance lies, even if this can never be absolute. What has been said here has little in common with the official view. It is one of the habits of Western statesmen to escape all too often from uncomfortable questions, for reasons of election strategy, into the abstract, until the day comes when these tactics become too obvious to be disguised any longer. Certainly President Eisenhower's statements on the alteration of the McMahon Act have shaken dogmas which only yesterday were considered infallible. My aim has been to illuminate the atomic problem from directions which have previously remained in darkness, with the purpose of stimulating further discussion of this vital problem. The leitmotif of the article is not war, but the search for new ways of ensuring peace without surrender.

Spy in the Sky

TOM MARGERISON

In this original article, one of Britain's foremost scientific writers examines the potentialities and limitations of photographic reconnaissance from planes and missiles

WITHIN THE NEXT YEAR or so the United States will have developed a reconnaissance satellite which, it is claimed, will be able to photograph the whole of territorial Russia from the air. There is little doubt that the Russians are also interested in such devices and their success in photographing the back of the Moon shows that they are developing the techniques required. How much can one expect to see from a satellite orbiting 100 miles or so above the earth's surface?

Many of the reports of what the reconnaissance satellite can achieve are obviously exaggerated. There are two main reasons for aerial reconnaissance. The first is to discover military targets such as missile sites or to look for movements of troops and equipment. The U2 flight, which ended with the aircraft being shot down over Sverdlovsk has been said, for example, to have been intended to obtain information about a new Russian long range rocket. This sort of work is essentially an extension of the kind of aerial photography used during the Second World War. The pictures obtained must be as detailed as possible so that the interpreters can pick out the details in which they are interested.

The second type of reconnaissance calls for less detailed photographs and is probably most suited to satellite vehicles. The purpose in this case is to determine accurately the position of targets so that long range missiles can be aimed at them. Essentially this is aerial surveying without assistance from the ground. Usually it will be enough to know the accurate position of a number of reference points which may be large and fairly obvious. If they are also targets, such as cities or large military bases, all the better, but the only thing required of the photograph is that the reference points shall be clearly recognizable. More important than the quality of the photographic detail is the accuracy of the navigational system used, since the precise position of the camera at the moment that it took the photograph must be known.

The need for these surveys arises because existing maps are insufficiently accurate to give the exact position of a place on one side of the globe with respect to one on the other side. And if the position of a target is not known accurately even the most perfect guidance system cannot ensure that a rocket will hit it.

One of the major causes of inaccuracy has been that surveying methods have depended on being able to see from point to point. This limits conventional map-making to the land and narrow strips of sea. It is only in the past year or two that the maps of Britain and the United States have been fitted to one another by the accurate determination of the distance across the Atlantic. The position, to within a few miles, of places in the more remote parts of Russia are still unknown in the Western world.

The simplest way of obtaining pictures from the air is with a camera no different in principle from the ordinary snap-shot camera. In theory, it is possible to take as detailed a picture as you wish from any height, although, as we shall see, there are practical limitations.

The aerial camera consists of a lens which throws an image on to a photographic emulsion carried on a film. The first problem concerns the emulsion itself. If you examine a photographic negative under a microscope the 'picture' can be seen to be made up of clumps of silver rather in the same way that the photographs reproduced in newspapers are made up of a large number of small dots. The clumps of silver are not noticeable in the ordinary way, but they limit the fineness of detail which can be seen in the photograph since, obviously, details of the same size as the silver clumps are bound to be lost.

Other things also limit the smallest detail which can be seen on a film. For instance, a pinhead of light focused on to the emulsion will penetrate into it and make a little splash of light round about so that the circle of darkness we see on the

developed film is larger than the original light striking it. The film used for aerial photography usually has a thin emulsion and fine grain and details 1/70th millimetre across or less can be distinguished.

But the emulsion is not the only factor limiting the amount of detail which can be seen in a photograph. The design of the lens is still more important. Even the best lens will not focus all the detail in the original on to the film. First, and most important for photography with ordinary light, slight errors in the construction or design of the lens prevent the rays of light coming precisely to a focus. Secondly, there is a limit to the amount of detail which can be seen through a lens of given diameter, due to the fact that light is made up of waves. The smaller the diameter of the lens and the longer the wavelength of the light, the poorer the detail which can be seen. This fundamental limitation on detail does not need to worry us when the photograph is being taken with ordinary visible light, since the limit is far below that set by the emulsion and by the errors in the lens. But photographs taken by radar, which has a wavelength of several centimetres, 100,000 times more than that of light waves, show only a limited amount of detail for this reason.

Limitations on Detail

To return to the aerial camera, a good lens will be able under laboratory conditions to produce an image on which details 1/150th millimetre apart can be distinguished. But when the lens is mounted in a camera and used to photograph a scene with relatively little contrast between dark and bright such as one observes from the air, the detail which can be distinguished is far less good – perhaps about 1/40th millimetre. When the camera is carried in an aircraft and operates with the engine running the detail is still further lost because of 'smearing out' by vibrations of lens and film. One of the advantages of a satellite is that it has no engine and therefore does not vibrate as an aircraft does. Taking all these factors into account it is rather unlikely that you would be able to see detail on the film which was less than 1/20th millimetre across.

Now this is what can be seen on the film. In theory a 1/20th millimetre patch on the film can be made to correspond to as small an object on the ground as we wish. It is simply a matter of designing a lens to give the right degree of magnification, just as outside broadcast television cameras can fill the screen with some small detail by using a long focal length lens, or can take a broad scene by using a short focal length one. The practical problem of designing lenses of long focal length limits the extent to which one can go. At the present moment the biggest cameras have a focal length of 48 in., which means that the 1/20th millimetre patch on the film would correspond with a square about 20 ft. across on the ground when the photograph was taken from a height of 100 miles.

This calculation makes a number of assumptions. It assumes that there is room for a camera of this size aboard the satellite. A camera is at least as long as its focal length, so the minimum size would be about 4 ft. long and 2 ft. in diameter. It assumes that the visibility is good and that there is a reasonable contrast between different parts of the picture. If there is even the slightest haze the earth looks greyish when viewed from a high-flying aircraft. The view from a satellite would be similar. The presence of dust and smoke acts like a veil and scatters the sunlight so that it slightly fogs the whole film. This means that we are looking for details on a plate which has been uniformly sprinkled with clumps of silver from the scattered light. The task of picking out features on the ground then becomes much more difficult and we could not expect to see a 20-ft., or even a 200-ft. object on the ground.

As I have explained, the contrast between the light and dark parts of the objects for which you are searching is extremely important. The smaller the contrast the more difficult it is to recognize the objects. This means that targets could be effectively camouflaged against reconnaissance satellites with a minimum of trouble. A relatively small amount of smoke released on clear days and the simple precaution of painting plant so that it did not contrast with its surrounding should effectively prevent its detection by satellite photography.

There are other difficulties which make the use of long focal length cameras in satellites unlikely. First, there is the problem of recovering the pictures. In due course engineers will develop satellites which return to earth and allow the films to be recovered intact. For the moment this is impossible and the pictures have to be sent back by radio. Two systems have been used. The first, developed by the Russians for their 'back-of-the-moon' picture, uses an ordinary film camera in the satellite. A method of developing and fixing the film automatically was devised and it was then

scanned by a photo-electric cell and transmitted to earth in the same way that newspaper photographs are transmitted across the world. Obviously this system cannot transmit more details than are in the original photographs and because of noise and faults in transmission it is bound to lose something, however small the individual strips may be into which the photocell divides the picture.

The Americans have been experimenting with a television camera system which was used on their *Tiros* weather satellite. In principle the sensitive plate of the television camera should be able to show up details 1/40th millimetre across, but taking into account all the other losses it seems unlikely that it could do better than 1/10th millimetre, which means that using a 48-in. lens the smallest detail of good contrast which could be seen on a clear day would be about 50 feet across.

The second main difficulty is due to the high speed of the satellite, which would be around 17,000 miles an hour. The longer the focal length of the camera the larger the scale of the photograph it takes. This means that the motion of the image on the emulsion, due to the movement of the camera over the earth, becomes very marked. If each exposure takes 1/50th sec. then during the time the shutter is open the image on the film will have moved 1 millimetre. The effect of this movement will be to smear the picture, just like any photograph of a moving object. The minimum detail which could be made out on the picture would then be about 2 millimetres across. The problem can be overcome by moving the film so that it keeps in step with the image, but where the speed is so great there are obvious difficulties.

Also, using the 48-in focal length lens, the field of view is very small. The size of the area photographed at each exposure depends on the size of the film. Most aerial cameras use film which is 9 in. square and this would cover a 20-mile square of country in a photograph taken from 100 miles with a 48-in. lens. Thus, if the camera looked straight down from the satellite, it should be possible to photograph a 20-mile wide strip right round the world and by doing this for a very large number of orbits the whole surface of the earth could be surveyed. But as each picture is only 20 miles wide and the satellite is moving at 17,000 miles an hour, 30 of these pictures would have to be taken and transmitted back to earth every second. The task is virtually impossible and would need 90,000 ft. of 9-in. wide film an hour. If a television system were used it is doubtful if a sensitive plate in the camera as large as 9 in. square could be used, and the task of taking photographs in a continuous strip and relaying them back to earth would be still more formidable.

Thus it seems unlikely that anyone will try to use reconnaissance satellites in the same way that aerial photography has been used in the past. The difficulties of building cameras able to reveal fine detail such as aircraft lying on airfields, or missiles being transported on railway trucks are too great.

The Satellite's Advantages

A satellite has one special feature. Once it has been launched and assumed its orbit, provided that it lies well clear of the atmosphere, its exact position can be calculated to a high degree of accuracy at any moment. This fact is being made use of in the *Transit* navigational satellites. It also offers one of the most important features of the reconnaissance satellite which makes up to some degree for the disadvantages of having to observe from such a great height. Since the exact position of the satellite can be calculated so accurately, the position of the objects which it photographs can also be calculated accurately, provided that the direction in which the camera was pointing at the moment at which it took the photograph was known. The satellite must be provided with equipment to point the camera towards the earth as nearly vertically as possible. The actual direction of the camera can be worked out accurately by arranging that it photographs the stars at the same moment as the earth. Then from the known position of the satellite and of the stars which appear in the photograph the exact position of the area of ground photographed can be worked out.

The only disadvantage of a satellite of this sort is that it can operate only during the hours of daylight and when the weather is very clear. This raises the question whether a radar camera might not be more suitable for satellite operation because it is little affected by clouds or bad visibility and will work equally well night or day. The disadvantages are first, that the satellite must provide an "illuminating" radar beam which requires quite a lot of electrical power and which could be fairly readily jammed by a country which did not wish to be observed, and secondly that the amount of detail in the photographs is markedly less good than medium focal length aerial photographs. As satellites increase in size the disadvantage of having to carry large power supplies may become unimportant. And it seems likely that by varying the

radar frequency in an irregular way the jamming stations might be made ineffective. The only question is whether the radar picture would be sufficiently detailed. This depends on the job to be undertaken and also on the size of the equipment which can be mounted on a satellite. Broadly speaking the larger the radar aerial in comparison with the wavelength used the more detail can be seen in the picture. The detail can be improved either by increasing the size of the equipment or reducing the wavelength. But there is a limit on the wavelength set by the absorption in the atmosphere.

Although neither radar pictures nor ordinary photographs taken from a satellite are likely to give the amount of detail about the goings on in other countries which military intelligence would like, their use for target mapping should be invaluable. And they should be useful, too, to indicate when the sky is clear over an area of military interest so that a reconnaissance plane can be sent out to get low-level pictures. In fact, it is interesting to speculate whether information from *Tiros*, the American weather satellite, was used to decide the right time for the ill-fated U2 flight across Russia.

Citizen Armies for Multi-dimensional Defence

FREDERICK M. STERN

From Orbis
Winter 1960

The author is the leading advocate in the United States of the citizen army. Here he suggests the reasons why it is necessary to examine the conventional views of most Western governments about the ways in which military manpower can be raised and trained
(By permission of *Orbis*)

To meet their opponents successfully, the free nations must recognize the multi-dimensional nature of the present world struggle. One analyst has aptly described it as a conflict 'protracted' in time, 'ubiquitous' in space and embracing 'the forces-on-the-loose in politics, economics, culture, science and technology.'[1]

This conflict can lead to large-scale war fought with the latest weapons, including the entire range of nuclear bombs. Thus far, however, it generally has taken the form of paramilitary actions and upheavals waged by subversion, terror and infiltration. In the rare instances when the conflict has flamed into open warfare, the battles were fought with conventional weapons. As the spectre of all-out war grows ever more terrifying, these minor forms of conflict are likely to continue to dominate the strategic stage.

The main question confronting the free nations, therefore, is not *how much* military strength they need, but *what kind* of strength: whether they possess sufficient forces with which to meet the full spectrum of Soviet challenges. Air, missile and nuclear power remain indispensable to deter or retaliate against all-out aggression. Yet, it is becoming increasingly evident – in Berlin, Laos and elsewhere – that our nuclear arsenal does not provide the most effective counter to limited communist challenges, nor to the piecemeal 'political' variety of aggression which has become the hallmark of communist conflict strategy. Dangerous gaps have opened in our defences – gaps which can be closed only through a concerted build-up of local forces.

The need for such forces is underscored by the fact that the various weapons systems which the Soviet Union has at its disposal are not to be considered merely as alternatives. Soviet strategy provides for the subtle *combining* of their use – or the threat of their use. During the Suez crisis, for instance, Moscow came to the aid of Nasser by threatening to supply 'volunteers' and to shower Britain and France with missiles.

Nor is their any assurance that the very existence of our nuclear stockpiles and delivery systems will deter the Soviets from large-scale aggression. Regard for human life and welfare never has been a virtue of Soviet leadership. According to a recent analysis of Soviet military writings, the Soviet High Command seems to view the possibility of Western nuclear retaliation with relative equanimity.[2] It is confident of winning a war which begins with a gruelling nuclear duel, because it expects that phase to leave the West without any effective defence forces, while destroying only part of the vast communist armies and army reserves. In the final or 'broken back' phase of a nuclear Armageddon, the Soviets count on their conquering armies to move into the vacuum of nuclear devastation.

The experience of the Second World War, in which the Russians turned the tide of battle after having suffered immense losses and destruction, lends encouragement to such a strategy. Certainly Soviet leaders would prefer to win the conflict with a minimum of losses, and therefore with a minimum of violence, by staging first political opera-

[1] Robert Strausz-Hupé, 'Protracted Conflict: A New Look at Communist Strategy', *Orbis*, II (Spring 1959), page 16.

[2] See Raymond L. Garthoff, *Soviet Strategy in the Nuclear Age*.

tions, then paramilitary gambits, and finally limited actions waged by conventional forces rather than risk all-out war in which nuclear weapons might be used. But if necessary they seem prepared to reverse this sequence of conflict.

It follows that large, effective army reserves are the key to any strategy which can cope with the contingencies of full-scale world war, limited war and paramilitary conflict. Yet, it is precisely in this kind of forces that the free nations are woefully deficient. Recently published estimates of the ground forces needed for NATO call for sixty reserve divisions of a high state of readiness, in addition to the thirty first-line divisions demanded by General Norstad. Both goals have gone begging, and the present political climate in Europe offers little hope that they will be fulfilled in the foreseeable future.

It is, indeed, a paradox that in an age in which man has learned to fly faster than sound, to exterminate millions of people with a single bomb and to penetrate into outer space, the creation of adequate conventional ground forces should be deemed impossible. Actually, there is a solution to the problem. There is a type of military organization which would enable the free nations to close the breaches in their defences and, in conjunction with those forces which they already have created, cope with the present conflict in all its dimensions. This type is the citizen army.

The Nature of a Citizen Army

The citizen army comprises virtually all able-bodied men, organized in peacetime by universal obligation. Its members pass through a comparatively short initial training period, and then serve in brief but intensive training assignments during subsequent years. Its personnel, including officers in high staff positions, consists of citizen soldiers, supported by a limited number of professional soldiers who perform permanent technical, administrative and training jobs and fill certain staff and command positions requiring continuity and full-time attention.

In a country that has professional or semi-professional forces at its disposal, citizen forces will not necessarily be equipped with the most costly and intricate devices. Those tools of war which are too complex or too dangerous can be reserved for the 'regular' forces, which may assign teams of specialists to 'beef up' citizen formations. The creations of such armies would not entail a neglect of our nuclear arsenal. Nor does it imply the abolition of other types of military forces – though the tasks of some of these eventually may be reduced.

A citizen army offers, indeed, the only plausible escape from a dilemma into which Western strategy has stumbled in the last decade – namely the need to compensate for inferior conventional ground strength with nuclear power. The West, by effecting a more logical balance of forces, weapons and tactics, might strengthen its bargaining position on such outstanding political issues as controlled nuclear disarmament. Equally important, the citizen army reduces the cleavage between army and nation. By establishing the identity, and thereby the unity, of the civilian and military spheres in membership, in leadership and in policy, it foredooms the time-honoured communist tactic of creating and exacerbating conflicts between citizenry, government and armed forces.

Mistaken Terms

The nature of the citizen army is widely misunderstood. Much of this misunderstanding stems from the mistaken equation of a citizen army with the semi-professional type of military formation, which includes what may be called the 'cadre-conscript' army and the 'militia'.

Professional military forces generally are weak in size. This weakness, however, has often been extolled as a virtue. The assumption is prevalent that only a small force can fully develop the talents within its ranks – that professional military forces, therefore, make up in quality what they lack in numbers.

Unfortunately, this belief is not borne out by the record. The quality of military personnel is as much a measure of innate intelligence, aptitude and character as it is of systematic, thorough and extended training. The fact is that the armed services in democratic countries never have been able to attract for permanent, professional service more than a fraction of the high-calibre personnel they need. Even in times of mass unemployment, the professional armies of Britain and the United States have persistently failed to achieve force level goals because they simply could not find enough qualified recruits.

These problems inhere in the very nature of a professional army. They can be alleviated but not eliminated by liberal financial rewards and improved conditions. A military career simply

does not appeal to all men. A young man who is interested, for instance, in science, medicine, or law, or hopes for a career in business or industry may gladly sacrifice the time needed to prepare him for his role in the nation's defence, but can seldom be persuaded to become a full-time professional soldier.

Similar difficulties mark the cadre-conscript army, the basic military model used by democracies today. It consists of sizeable 'cadres' of professional personnel who command a large number of conscripted civilians serving for lengthy 'hitches' in the lower ranks. In wartime, the non-professional members of such an army are given ample opportunities for specialized training and advancement. But in periods of formal 'peace' – periods which should be used to prepare men for their wartime tasks – professional soldiers have first call on responsible posts and commensurate training.

The citizen army, by contrast, avails itself more rationally of the principle of universal obligation. Its methods of selection and training are designed to make optimum use of the wealth of talent a nation has to offer and to exploit fully the capacity for rapid learning which capable men possess. The immense pool of high-calibre personnel from which it can draw enables it to be highly selective in the choice and promotion of specialist, staff and command personnel.

The historical achievements of citizen armies bespeak their high calibre. The most notable among them, the Swiss, has not been tested in combat, but boasts an untarnished 'record of deterrence' dating back to the dawn of the nineteenth century. The citizen armies of two other nations, which were less fortunate in avoiding conflict, have distinguished themselves on the battlefield. One is the army of Israel, which repeated its splendid performance in the Palestine War in the Sinai Campaign of 1956. The other is the Australian Army, which proved its worth at Gallipoli and, on August 8, 1918, in the battle of Amiens. There, on Ludendorff's 'black day', it achieved, together with the Canadian Army, a decisive breakthrough which turned the tide of the First World War.

The citizen army concept has often been disparaged, primarily because it has been confused constantly with existing 'militia' formations. Indeed, the dividing line between these two systems has never been drawn clearly. In Europe, genuine citizen armies such as the Swiss – i.e. armies based upon universal peacetime training – are often called 'militias'. But in the United States, the term 'militia' connotes formations of non-professional soldiers who volunteer in peacetime or are conscripted only in times of national emergency.

This confusion of terms has led to blanket criticisms of all citizen-soldier systems. It is argued, for example, that such armies cannot achieve an adequate level of constant preparedness. The validity of this criticism is questionable even where addressed to militias or the reserves of semi-professional armies. The British Territorials and most units of the American National Guard, to illustrate, were found at the outbreak of World War II to possess a higher readiness potential than had been anticipated. Certainly the criticism does not apply to citizen armies. The Swiss, for instance, are able to mobilize part of their forces within hours and the remainder in no more than two days.

One element of a well-disciplined citizen army's strength is incontrovertible, namely morale. There is none of the endless, exasperating waiting and 'soldiering' which have filled the draftees of cadre-conscript armies with a sense of frustration and apathy. The citizen army is a rigorous training school for defence. It assigns to every man, even in peacetime, a clearly defined responsibility, and offers him the greatest possible chances of advancement. Thus, it instils in its ranks the kind of spirit which dictatorships seek to whiplash, often unsuccessfully, with boisterous slogans and systematic psychological conditioning.

The Dimension of Time

How do the various military systems in existence cope with the different 'dimensions' in which the present world conflict is being waged?

The first of these is the dimension of time. Protracted conflict requires, next to forces of the professional or semi-professional type, a system which can be relied upon for decades – and if need be for centuries – to furnish in case of war large, fully organized and effective reserves, at all times poised for immediate action. Such 'protracted preparedness' is possible only if the burdens of defence are deemed bearable by the nation concerned – bearable not only in terms of the nation's economy but of the psychology of the people. Bearability should not be confused with cheap popularity, laxness, or 'coddling'. What matters

is that the training should not interfere more than absolutely necessary with a man's education and civilian pursuits. Nor should it bore or humiliate him by leaving his presence in the service and such militarily valuable qualifications as he may possess to a large extent unused. The psychological factor looms decisive in a conflict which remains essentially a war of nerves. A dictatorship can impose the most onerous burdens upon the people and maintain them indefinitely; a democracy which tries to accommodate a basically unpopular military system is bound to see its defences crumble as soon as the danger from abroad seems to subside. The totalitarian aggressor, recognizing this fundamental weakness, is able to bide his time, meanwhile adroitly playing upon the themes of 'peaceful coexistence' and 'relaxation of tension' in order to induce his opponent to drop his guard. Mao Tse-tung's assertion that 'a strategically protracted war and a campaign or battle of quick decision are the two sides of the same thing' should be taken as a warning. The citizens of a democracy must always be prepared for sudden brutal aggression, no matter how long the conflict may last – at any time, anywhere, and by any means. And in the long run they cannot rely upon a defence system which they themselves accept only grudgingly.

The citizens of Switzerland have supported their military system enthusiastically for centuries, notwithstanding the weight of this burden in terms of taxes and the citizens' time and personal efforts. The Swiss have shouldered the load precisely because it forms an integral part of the life of every able-bodied man and is not a system reserved for a limited corps of career men nor a temporary demand imposed by the caprices of international affairs. The Swiss citizen regards his military preparedness not only as his civic responsibility but as his supreme civic right.

As a small nation surrounded by first-class military powers, Switzerland probably would not have survived as an independent nation without its army system. It could be argued that the barrier of the Alps has been a powerful factor in this survival story. Be that as it may, geographical location, along with size and wealth, have ceased to spell security. The dictates of the present conflict should make it clear to free nations everywhere that they must supplement their existing forces by the type of mass formations which are effective and, at the same time, compatible with the psychological make-up of democratic society.

The Requirements of Ubiquity

The second dimension of the present conflict is its ubiquity. In strategy, factors of time and space are always closely meshed. An aggressor who attempts to defeat his opponents in a drawn-out campaign of attrition will seek to widen the geographical scope of the conflict and constantly to shift the focus of his operations. And the communists employ not only invasions by military forces, but violent actions of minorities which must try to usurp power at their behest. Such actions can only be countered by indigenous forces.

The idea has gained wide acceptance that highly mobile forces with tremendous firepower, if rapidly transportable, can replace strong indigenous armies. There is no discounting the strategic virtues of such forces. But it is illusory to believe that they can fully compensate for ubiquity. For one thing, staging grounds, airfields and naval installations cannot be made mobile, and vehicles are vulnerable to enemy attack. Secondly, the high cost of such operations tends to limit their size. Finally, it is infinitely more difficult to dislodge an invader once he has gained a firm foothold than it is to repel his initial assault. Troops flung into conflict over long distances can arrive only *after* the event. They are therefore less of an obstacle – and of a deterrent – than defensive forces already on the spot.

This contrast in effectiveness was brought out sharply in the Sinai and Suez campaigns of 1956. The citizen army of Israel, though weak in arms, ammunition and vehicles, was successful because it was strong in quality and numbers and *because it was there*. The air and seaborne troops of Britain and France, on the other hand, though staging their operations from nearby Malta and Cyprus, and better equipped than the armed forces of Israel, were unable to prevent the blocking of the Suez Canal or to occupy more than a small part of the Canal zone.

In sum, the all-embracing offensive of the enemy must be opposed by an ubiquitous defensive structure of the Free World. As long as the Western Powers entrust their defences exclusively to professional or cadre-conscript forces, they will find it impossible to amass at any given point sufficient strength to meet a concerted thrust by the enemy – and to do so in time. The Korean War made this clear. When North Korea struck across the 38th Parallel, the United States had more than enough men under arms to deal with

the challenge. Yet, the US Joint Chiefs of Staff did not dare to withdraw Army and Marine divisions from other parts of the world and were forced to send to Korea several divisions of the principal citizen force of the United States, the National Guard.

By obviating the recourse to reinforcements from the United States and her principal allies, the presence of strong indigenous forces would go far to prevent the spreading of a local conflict into a large-scale conflagration.

Defence in Depth

Ubiquitous defence has become a necessity not only in breadth but also in depth. The technology of airpower has totally revolutionized strategy: a country must be defended today not only at the frontier but *everywhere*. Territorial forces must stand constant guard against destruction and invasion from the skies. Such forces can man ground-to-air missiles, interceptor planes and other weapons to ward off airborne invaders. In addition, 'civil' defence, needed for disaster control and preservation of public order, must be organized effectively lest panic and breakdown of civil order spell disaster. The reserves of a citizen force can provide a reliable cadre for these assignments.

Finally, territorially ubiquitous forces may be needed for combat operations *behind* the lines of an advancing enemy. Citizen forces, properly trained, can strike to cut off armoured forces advancing swiftly in the fashion of the German Panzer columns that rolled into France in 1940. They can harass and disrupt advancing mass armies. In occupied parts of a country they can make things so difficult for the invader that he blesses the day he can withdraw. Improvised guerrilla forces have been successful in many wars; it stands to reason that citizen army contingents, carefully trained and organized for guerrilla war beforehand, will be all the more effective.

Economy and Technology

Let us consider next what may be summarized as the economic, scientific and technological dimensions of the global conflict.

Nations have found it possible in the past to throw all of their energies and resources into a conflict of relatively short duration; they will find it infinitely more difficult to maintain a massive military establishment for decades, let alone centuries. Under present systems, the armed forces of free nations, if they were really to be strong enough, would be forced to syphon from the mainstream of national life a substantial proportion not only of a country's manpower but also of its technical skills and creative talents. In an era in which factory and laboratory have become important staging grounds for conflict, such raiding of a nation's human resources is fraught with growing risk. In the long run, even the present military setup may place too heavy a demand upon skills and talents, thus undermining the very foundations of a nation's total defences. A citizen army solves this dilemma by versing the citizenry in the arts of war without derailing the engines of national power.

The financial burden of a citizen army system, too, is lighter. A Swiss expert found, in 1952, that the military expenses per inhabitant in Switzerland were 173 Swiss francs, as compared with 334 Swiss francs in Great Britain and 1,446 Swiss francs in the United States. These savings were due to the brevity of training periods and the smaller cadres of professional military personnel required for training and commanding citizen army formations. If conditions approaching ubiquitous strength can be achieved, savings can be realized also in transportaton and logistics, while the refresher courses keep the trained units much longer available.

Additional defence economy is possible if the citizen army idea is adapted to air and naval power. Obviously, the operation and maintenance of airplanes and ships requires more and longer specialized training than do regular army formations. Yet, the excellent performance of millions of civilians who were drafted into these services during both world wars indicates that here, too, the readiness potential of the free nations can be increased significantly through citizen soldiers.

The Factor of Morale

Perhaps the most important potential benefit of the citizen army system in the present world conflict is its impact upon the spirit of its members and of the nation as a whole.

Intrinsically, the army of no nation can be stronger than that nation's will to resist. In the final analysis, morale is a measure of the ability to resist, which, in turn, is a compound of training and organization.

Historically, many peoples, for example the Boers in their war with Britain, fought effectively without benefit of 'regular' army formations and with outmoded weapons. The 'militias' in the American War of Independence, drawn from farmers and townspeople and trained hastily and scantily under universal training laws of their colonies, produced courageous and even disciplined fighters. The communists have always recognized the value of this 'militia spirit'. One of the most interesting observations reported, for instance, during the war in Indochina concerned the spirit of the men who in the daytime attended to their farms or jobs and at night became secret members of the communist 'irregulars'. These men were given weapons and trained for definite responsibilities in a disciplined unit. Most of them were attracted to the communist camp not by the abstract theories of Marx, Lenin or Mao Tse-tung, but by their flattered pride in being entrusted with responsible tasks in paramilitary formations.

Ultimately, such spirit can be countered effectively only in kind. The citizens of a democracy which relies on a professional military corps invariably take a dim view not only of the men in uniform but of the harsh necessities of defence in general. A similar bias tends to prevail among men who are arbitrarily removed from their civilian careers for long periods of 'soldiering'. In short, wherever the physical divisions between military and civilian endeavours are absolute, these barriers tend to penetrate deeply into the psychology of a nation.

The citizen army, by contrast, translates 'defence' from a remote or abstract concept into a personal and permanent experience. The stronger morale which derives from a superior understanding of defence needs and assignments tends to be transfused into the nation as a whole. It strengthens not only the military establishment. In a democracy, no policy can be maintained for any length of time if it clashes consistently with the mainstreams of public opinion. An all-too-'civilian' nation which regards defence as a remote, enigmatic and generally distasteful phenomenon, will be inclined to respond erratically to the challenges of a purposive enemy – to belittle the danger of a violent conflict or to overrate it; to be complacent or panicky; to support political and military adventures or to hoist the flag of surrender at the first setback. The citizen army, by giving military training to all able-bodied men and by imparting higher military education to a much larger portion of the citizenry than any other army system, engenders a wider understanding of the harsh realities which foreign policy must take into account.

The Outlook

There are a number of ways to organize a citizen army. In the United States, for example, the National Guard and the Organized Reserves could serve as the core of large citizen reserves. This was what the former president of the National Guard Association, General Ellard E. Walsh, had in mind when he demanded universal training in the National Guard for all Americans of draft age who would not enlist in one of the other military services. He thus proposed to make compulsory a programme similar to the one which the Reserve Forces Act of 1955 has made available to volunteers – one which provides for a six months' training period followed by short, intensive courses in later years. In Britain, the various reserve contingents, and above all the Territorials, could form the nucleus of a similar programme.

The relationship of citizen forces to the professional armed forces of a nation will depend partly on the possibility and advisability of entrusting certain weapons to citizen soldiers. In this respect, the needs will differ from country to country. It should be borne in mind, however, that many complex weapons systems and instruments can be handled competently by trained civilians. When Switzerland introduced tanks and jet planes, its army planners were surprised at the speed with which citizen soldiers learned to master the new devices. It is significant, also, that most of the ground-to-air missile stations in the United States are manned by the National Guard.

No matter whether or when the United States and Britain are going to build citizen armies, their citizens should familiarize themselves with a system that can vastly improve the political stability and military security of nations more directly exposed to communist aggression. The advantages which those nations can gain would soon reduce the heavy burdens now borne by the United States, Britain, and their principal allies.

It has become trite to assert that time is growing short. Yet, the accelerating tempo of the conflict makes it clear that time is becoming the most precious commodity in the struggle for survival. Given the lead-time problems which beset Western defence strategy, the decisions which will

determine the conduct of policy – or of the battle – five to ten years hence must be cast today.

In the words of Arthur Koestler, 'Free men must be prepared to defend their freedom or lose it.'[1] The idea of the citizen army is a concept of immense promise which, once fully understood, will enable the free nations to beat the communist dictators at their own game – the game of protracted and ubiquitous conflict.

[1] *The Trail of the Dinosaur*, New York, 1955, page 240.

'There are 280,000,000 people living in the countries of Western Europe. If you would accept the generally believed doctrine that a country with a high standard of living could afford one division per one million inhabitants, those 15 European nations could organize 280 divisions. Switzerland has gone much farther and organized 15 mobile field units of division size, i.e. three divisions per million inhabitants, as well as an even larger number of big units for static defence tasks. By the Swiss standard, Western Europe should be able to organize 840 divisions! Of course, there will be never as many divisions as that, but this mathematical example shows that the actual number of Western European divisions is only about 5 per cent of a real all-out effort. And this figure is surely too small for conventional warfare.'—From 'Has the West Neglected Conventional Armed Forces?', by **Major General Max Waibel**, Chief of Infantry, Swiss Army, in *The Fifteen Nations*, June 1960.

Strengthening Europe's Defensive Power

URS SCHWARZ

From Neue Zurcher Zeitung

February 21, 1960

Here the military editor of one of Europe's leading newspapers examines the same problem in the light of Swiss experience

(By permission of *Neue Zurcher Zeitung*)

IT IS A favourite jibe that the military are always preparing for the last war. Although there may once have been some truth in this – and this is possible, even for maxims which enjoy universal popularity – the accusation is no longer true today. The technical revolution which became apparent in the last months of World War II continued without interruption in the period of armistice and uneasy peace which followed it. People were – and are – so acutely aware of it that it influences their entire thinking; it has also gained a hold on military thinking. The vital point is that the revolution by no means applied only to military technology. The days are long past when technology essentially served the art of war and when an engineer was thought of only as a military figure. Scientific research and the wholesale exploitation of its results have transformed the world for the civilian as much as for the soldier and have altered the structure of civilian life as much as military planning. It is characteristic that today strategic problems are no longer the prerogative of general staffs, but that the most significant contributions are made in Universities and civilian research institutes.

Military thinking and planning today have thus turned right away from the last war. True, its events are analysed as a source of experience, but it does not even occur to anyone that a future conflict must in any way resemble the last. Rethinking has flourished to such an extent that the extrapolation may have gone too far, we may be abandoning the solid ground beneath our feet and sailing off into phantasies of the future. The surprise element of a future conflict might lie in the use of old and tried, but none the less terrible weapons, instead of the latest offspring of science and discovery. A necessary and proper detachment from past experience as such, and a deliberate and fruitful discussion of present and future possibilities, have produced much knowledge on which we shall be able to rely. The number of hypotheses emerging from this is so great, however, that many uncertainties have also arisen. Whereas we may previously have thought that we knew roughly what form a future war would take, and were then bitterly deceived, the abundance of conceivable and considered possibilities today is such that we are exposed to grave doubt and therefore crippled in our powers of decision.

Two Spheres of War

Doubt as to the future picture is reinforced by the circumstance – which dominates the whole development and is obvious to everyone – that the world of military weapons has split into two distinct spheres.

On the one hand, we witness the development of nuclear and thermonuclear exposives and biological and chemical means of warfare and the carriers which can deliver them over great distances. The absolute weapon-carrier, that is, one which can reach any spot on the globe from any other spot, is already in existence and will be taken more of less for granted in a few years' time. The destructive power it carries is so great that any territory hit will be devastated over a wide area. The side-effects may extent indiscriminately over far greater areas. The trajectory and speed of the carriers and the possibility of error over their flight are such that an impregnable defence is out of the question. Alongside this highly developed form of weapon are arrayed in descending order countless others with maximum, long, medium and short ranges, and with limited, but still

essentially indiscriminate destructive power. Among these carriers are missiles of every type, propelled by rocket or atmospheric air-consuming motors, ballistic or teleguided, manned bombers of varying range and submarines.

On the other hand, we are concerned with building up forms of military equipment, and suitable troops to deal with them, which fall under the heading of 'conventional'. The first group and this one do not differ simply in that the latter do not make use of nuclear explosives. The difference lies rather in the fact that pinpointing of targets and accurate firing are sought at the expense of range and that these instruments always serve a military purpose to be executed by human beings, whether it be conquest and occupation, or defence and the retention of definite zones and regions. The two spheres of war are linked by the political and psychological warfare which stands between them and spares no means to undermine the defensive capability of the enemy, to cripple his aggressive power and to ensure for one's own weapons an effect on the bodies and spirits of the enemy which starts before the first shot is fired.

According to their temperaments and abilities, peoples and governments have laid more emphasis on one type of war than the other. It is indeed no wonder that only the two real world powers can undertake to be strong in all sectors. Indeed, it has become the criterion of a Great Power to be able to maintain conventional and strategic forces, to make use of these rather inexact definitions. It is up to the others to make a choice between the two, a decision which is usually anticipated by circumstances.

Theoretical consideration of the problem of this choice has produced solid results in recent years: the assumption that 'deterrence', by means of the big weapons, could protect one from all attack has been destroyed. The possibility that such weapons could not be used at all, since when used by the two sides they would bring destruction and ruin to both, has been recognized. Thus an attack with conventional armies is still a form of war with which both the possessor of the big weapons, and a country which does not possess them, must reckon. Equally, an attack with undermining weapons must be reckoned with at all times and in all places. Conventional armament is therefore essential, either for defence or to prevent an attack from taking place at all. This means that a genuine choice is no longer possible: anyone who has not at least the means of a conventional defence adapted to his circumstances, is basically defenceless.

Great Britain, which in the White Paper of April 1957 declared in favour of a strategy based principally on the deterrent, in order to throw off the burden of obligation to arm generally and to effect economies, provides an example of a wrong choice. Considerable alterations have already had to be made in this plan. The basic importance of, and unavoidable necessity for strong conventional forces are now generally recognized. Opinions differ as to their organization, armament and possible methods of warfare. Such forces, which have to be adapted to the conditions of the various countries concerned, must essentially differ from country to country.

Conventional Forces

The creation of adequate conventional forces to ensure the security of Western Europe in the face of the mighty armies of the Soviet Union and her satellites, sets grave problems for all European states. These may be defined in a few words: sufficient resources of manpower must be produced without prejudicing the economy of the country, on which its defence potential rests. The armies must be given adequate training to meet the demands of modern warfare and the complications of modern weapons and their level of training must be maintained. The ever-increasing costs of such armies must be met without jeopardizing the fulfilment of social commitments in the widest sense, which the modern state cannot avoid. The will of the citizen to sacrifice time and money for military service must be created and maintained. A high degree of readiness must be maintained constantly over years and even decades, in order to deal with an attack even at times when no signs of severe international tension are apparent to the people.

The difficulties encountered by NATO in producing the minimum requirement of defence forces are a reflection of these problems. But even the Soviet Union, where a dictatorial government can dispose at will of a politically subject people, has to face the same difficulties. For them, it is the necessity to divert sufficient labour for the realization of their industrialization plans, which sets limits on the formation of the conventional armies.

For the free world, the solution to a great part of this problem might be found in the exploitation of the possibilities inherent in the militia system. This has three main advantages: relatively low

costs of national defence; the possibility of maintaining large armies in a high state of readiness, without keeping people away from their civilian activities; emphasis on the responsibility of the civilian for the safety of the country. The principal disadvantages are that only a few troops are constantly under arms, that training does not measure up to the highest demands and that a complicated organization, affecting the entire life of the nation, is necessary.

Resistance to the militia system comes less from considerations based on these genuine disadvantages than from mere prejudice. Military men in almost all countries are unable to imagine anything but the mass armies of the nineteenth century, made up of professional soldiers and conscripts. Although these armies have failed – militarily in France and politically in Germany – they are still regarded by the military as the only worthwhile goal. Examples of the successful use of the militia system – Australia, New Zealand, Canada, Israel, Switzerland – are scarcely considered. The feudal tradition, which affects almost all armies, has prevented them from really facing up to the possibilities offered by the militia system. Conversely, the militia system was often played off against the traditional army by its opponents as a sort of popular resistance to the army itself, and therefore became doubly suspect to the professionals. Today, however, if serious consideration is to be given to the long-term security of Europe, the militia system should everywhere be treated as a weapon of the democratic state in the atomic age.

Of course, a major power cannot depend on a militia alone. It will always need a standing army or even professional troops. Weapons and equipment which call for long and thorough training will be better used in the hands of officers and soldiers who are professionally familiar with them. Fleets and large air forces need professional officers and long-service crews. However, to link such units with militia armies would promise an ideal solution.

The Citizen Army

The costs of a militia army are low because there is no need to provide barracks for large numbers and because a great deal of the administrative work is taken on by the civilian in his free time. Switzerland spends 4 per cent of its national income on defence, amounting to about 180 francs per head of the population. After the imminent modernization of the army this sum will increase to 210 francs. In the United States the corresponding expenditure would be equivalent to 1,500 francs, and in Great Britain to 350. A comparison with France is interesting. Even before sending an army to prosecute the war in Algeria, France, with a population ten times as great and a military budget twenty times as high, maintained an army and air force scarcely twice as large as those of Switzerland. In addition, of course, there was the small but expensive fleet.

The greatest advantage of the militia system, however, is that it creates a tool better suited to warfare in the atomic age than any other form of defence. The view, long current, that the introduction of atomic weapons and the consequent diminution of army units would automatically allow a decrease in the number of available troops, is one of those foolish errors which are paid for in war by reverses or even defeat. More troops are needed today. Every part of the country to be defended is in peril, unless it has almost unlimited depth at its disposal. Only a citizens' army is capable, under European conditions, of supplying and maintaining the large number of troops needed for a real defence in depth. Hostile infiltration, paratroop commandos, revolt, defeatism spread by the enemy, catastrophes caused by nuclear or biological weapons, are phenomena of modern war which implicate the entire country. A nation, of which a great proportion has gone through the school of the citizens' army and whose members possess both military training and organization will be able to meet these internal dangers and misfortunes far better than a population which relies on a small, professional standing army, however technically perfect. Only an army which possesses enough troops to be able to intervene throughout the country can prevent collapse under the powerful blows of modern warfare, or may still be able to save something from the ruins of catastrophe.

The confidence reposed in the civilian as a military trainer and leader – the civilian, who constantly returns to his profession between his periods of military service – meetings between men of differing professions as soldiers and officers, the continual lively exchange of experience between civilian life and the military, all help to create a climate which can only be beneficial to any state. By handing over part of the equipment to the civilian one is transferring responsibility to him and showing him trust. In the militia system

there is no split between the soldier and the civilian, or the army and the people, nor can a militia army become an instrument of blind obedience, capable of misuse for a purpose for which it was never intended. It is simultaneously an army and a people.

NATO and the Militia

The purely military advantages of a citizens' army are such that it can no longer be justifiable for NATO not to give serious consideration to the inclusion of the militia system in its organization, or for its members not to build militia-type units into the framework of their national defence. With the present method, it is impossible to maintain simultaneously, mechanized units with striking power, their appropriate tactical air force and also the divisions which can intervene from depth and protect a country over its full extent. At the speed with which an attack can be delivered today – even excluding an attack by missiles or strategic bombers – it is unthinkable to rely on the mobilization of reserves in the usual form, which takes several months. The modern formula for Western European countries must be: long-service mechanized troops and air forces of great striking power but limited size – and divisions of a militia-type army which can be instantly mobilized and are already well trained.

It is notable that in the Soviet Union the decrease in size of its army, announced a few weeks ago, coincided with the news that the demobilized soldiers were to form territorial units. Although quite different motives may be involved from those which guide the democratic countries of the West, yet the fundamental idea is as valid there as it is here: the task of modern defence can no longer be carried out in the traditional form.

A politically and strategically attractive solution might be for the long-service or professional units, the tactical air forces and the front-line mechanized divisions to be set up on a supranational basis. They would make up the NATO army, independent of its individual members. In addition, each member would have to form a fairly large number of militia-type divisions. They would be attached to NATO on the lines of the units now under its orders, but would retain their national character. The advantages of this solution are obvious: it would strengthen the solidarity of the alliance, make it practically indissoluble, enable the contributions of all the allies to be fixed flexibly but lastingly and put a homogeneous striking force at the disposal of SHAPE.

Obviously, existing militia systems could not simply be transplanted unaltered from one country to another. The close relationship between national character, political idiosyncrasies, traditions and economic conditions of the country which is peculiar to the militia, makes it essential for different solutions to be found in each country. In a country such as Germany, quite a lot could be done by way of transferring unofficial duties, as for example in entrusting equipment and weapons to the militiaman; in other countries a certain restraint and strict supervision would be called for. Whether he be Swede or Sicilian, however, it is in the nature of man to repay trust with trust as a general rule. If we believe in the possibility of democracy, then we must also believe that we should allow the civilian to participate in its defence in a far more intensive form than hitherto. One, two or three years of military service, which then leave the civilian unconcerned in his country's military preparedness on the outbreak of a grave crisis or of war, will not develop the citizen whom the age demands. A purely military hard core of officers and NCOs cannot, despite all its democratic zeal, stand in the same intimate relationship to the everyday life of the people and the state as the officers' corps of a militia army. The army and technology, which dominates everyday life today, are more closely interdependent than ever. Only when all the abilities, all the experience of the civilian professions are made available to the army, will it become the great, modern army which the democratic countries need today. The experience derived from professional life will close many of those gaps in training which have to be reckoned with in a citizens' army.

But we must have confidence. Confidence in the good qualities, ability and will of the peoples of the West. If this confidence is summoned up and given expression in a defence system based upon it, the result will be a recrudescence of the self-confidence so essential today in the face of the constant threat and challenge of the East.

Book Reviews

DETERRENCE OR DEFENCE

A Fresh Look at the West's Military Policy
B. H. Liddell Hart:
London: Stevens & Sons, 30s.

The sub-title of Captain Liddell Hart's book is a little misleading. This volume is, as the author makes clear in his preface, a collection of studies written over the last two or three years – two indeed date back to the first half of the decade – some of which have already appeared in print. In spite of skilful blending and extensive re-writing the chapters still give an impression of having been written separately, without reference to any overall scheme of work, and in response to different historical stimuli; and the publishers would add to the interest of the book, without in the least detracting from its value, if they gave some indication as to which of the contents had already been printed, in what form, where, and when. It would at least provide scholars with a useful key to the evolution of the thought of the most penetrating military critic of our time.

Captain Liddell Hart brings to the study of military affairs two qualities, neither unusual in itself, but in combination virtually unique. The first is a grasp of grand strategy, based on a wide study of history which has led him to develop a philosophy of war comparable to that of Clausewitz in its insistence upon the necessary primacy of political considerations in all military operations. The second is an expertise in the *minutiae* of tactics, weapons and organization for land warfare which is kept meticulously abreast of the unfolding technology of war. This expertise to some extent determines his approach, especially in this latest book. The sailor will find curiously little about global strategy and sea power. The airman will complain, possibly with more justification, that the author ignores those subtle and unending speculations over massive deterrence, finite deterrence, minimal deterrence, and first and second strike forces, of which military theory is coming increasingly to consist. For Liddell Hart the battle is the pay-off, and ground forces exist, not to trigger off any global process of mutual extermination, but to fight battles – and fight them economically, efficiently, and decisively.

This belief has made him a constant critic of the posture and philosophy of NATO; and it has made his the most powerful voice raised in protest against the increasing dependence of the West on 'tactical' nuclear weapons whose use, it is almost universally agreed, could not be confined to the battlefield. But his criticism is always constructive. Instead of reliance on weapons whose use would, for Western Europe at least, involve national suicide, he re-emphasizes the viability of conventional weapons in the defence, even against overwhelmingly superior odds. Here his mastery of tactical detail is invaluable. He shows how the number of men required to hold a given length of front has, as weapons have developed, steadily shrunk. Twenty thousand men were needed to the mile in Napoleon's day; 2,000 was usual in the Second World War; while in the Normandy campaign – to quote no examples from the Russian front – the Allied troops, fresh, superbly equipped and with complete dominance of the air, seldom succeeded in breaking the German lines with a superiority of less than five to one. On this analogy, the West could with little difficulty raise and equip enough conventionally armed divisions to defend NATO's central front against the strongest forces that the Russians are likely to deploy against it. Nuclear weapons should be held only by special units and used only as 'a last but one resort'. For the vulnerable Northern and Central Fronts it would be wise to provide, as reinforcements, forces of those highly mobile amphibious troops whose value, both military and political, is analysed in one of the most instructive articles in this book. And finally, the fighting effectiveness of all these front-line forces should be maximized by new tactics of 'controlled dispersion'; by the extensive use of night action; by light, hard hitting, air-transportable tanks; by helicopters, and zero ground-pressure vehicles; and if necessary by the use of a weapon far more humane than nuclear armaments – gas.

There remains one gap to be filled in the chain of Captain Liddell Hart's argument. The forces which he has in mind are designed primarily to deal with emergencies and provide 'a non-nuclear fireguard and fire-extinguisher'. He attacks the 'soldiers (who) still think in terms of a lengthy war and of winning it, (who) tend to put the requirements – in men, equipment, and money – much higher than the statesmen feel they can meet'. Yet if a purely conventional defensive system did prove effective in repelling a conventional attack, and nuclear war was not unleashed, a lengthy war of the Korean type might easily ensue; and there would enter into the battle not only the elements, which he discusses so shrewdly, of Force and Space, but a third to which he devotes little attention: Duration. Military organizers are not misled in being worried by this aspect of conventional war, and it raises problems which mobile élite troops are not well equipped to solve. Captain Liddell Hart is not blind to this question. He touches interestingly on the idea of militia-type forces, 'a superior type of Home Guard, (which) would provide a deep network of defence, yet need much less transport than the present NATO type, be much less of a target, be less liable to interception, and become effective with far greater training'. But he does not seem to have devoted to this problem quite the amount of sustained thinking which is evident elsewhere in the work. Perhaps that will soon be forthcoming. Fire-extinguishers can deal with accidents; but we would be rash if we assumed that accidents were the only emergencies for which the West had to prepare.

MICHAEL HOWARD

THE SOVIET IMAGE OF A FUTURE WAR

Raymond L. Garthoff:
Public Affairs Press, Washington, D.C., $3.25.

COMMUNIST CHINA AND ASIA

A. Doak Barnett:
Harper and Brothers,(for the Council on Foreign Relations). London: Oxford University Press, 56s.

Although Dr Garthoff's book is concerned with the Soviet image of a future war, and Mr Barnett's is a thorough investigation of the whole field of the Chinese impact on the outside world – particularly on the United States – there is one area where the two books deal with the same subject, and make extremely interesting joint reading: the intentions and capabilities of the Soviet Union and China in the field of foreign affairs and in exercising pressure on the non-Communist world.

Dr Garthoff concentrates on the military aspect of this problem, and his book is a carefully documented and detailed presentation of the evidence, valid at least up to 1959, from which we can learn the foundations of Soviet military thought in the era of nuclear weapons. These are, as the author explains, that no one weapon, however terrible, can win a war between Great Powers with vast territories, and that therefore the concept of victory as a result of an all-out 'blitzkrieg' launched either by the United States or the Soviet Union is no longer realistic. Soviet military thinkers believe that wars are still won or lost in a clash of armies, navies and air forces, resulting in the destruction of the armed might of one side or the other. Therefore a future global war is more likely to be long than short, and to require more men in the forces than ever before. Dr Garthoff quotes from a Soviet military journal *Military Herald* on this point:

> The appearance of atomic and hydrogen weapons is considerably changing the face of war, but of course, war cannot and will not be only an atomic-hydrogen war. Use of these weapons not only does not abolish the conventional armed forces but leads to their augmentation . . . The possibility of great losses will also lead to a significant growth in reserves – strategic, operational and tactical – which in a future war to a far greater degree will be required to compensate for casualties.

This quotation comes from the first of three appendices to the book in which Dr Garthoff includes translations of important articles written by leading Soviet military theoreticians on the character of modern war, the factors which decide its outcome and the way in which Soviet military planners are tackling its problems.

Dr Garthoff's book is a highly convincing presentation of a very specialized subject. Mr Barnett's work on Communist China and Asia is an exhaustive treatment of the whole problem of China in the modern world, in which he deals with such widely differing aspects as the Sino-Soviet alliance, the chances of a Nationalist return to the Chinese mainland from Formosa, the role of economic aid and trade in Chinese foreign policy, the place of the overseas Chinese communities in the Chinese picture, and an estimate of a promising policy which the United States could adopt towards China. But perhaps the most interesting sections in this long book of 500 pages are those relating to the motive power behind Chinese foreign policy, and the means which the Chinese Communists would be prepared to use to achieve their aims.

Mr Barnett correctly emphasizes the need to study and understand the thought and career of Mao Tse-Tung as a preliminary to any appreciation of the Chinese Communist position. After tracing the development of the Chinese Communist Party under Mao's leadership, and the foreign policy of the Peking Government since 1949, the author concludes:

> As of the early autumn of 1959, there is little to indicate that the Chinese Communists have, in fact, decided to pursue a general policy of large-scale aggression. The new pressures they have been exerting on China's neighbours have to date been limited pressures, and apparently Peking's aims in regard to the Sino-Indian border and Laos have also been limited. In both of these situations, in fact, local factors rather than broad tactical considerations seem to provide the main explanation for Peking's recent actions . . .

This conclusion appears to be fully justified by the evidence presented by Mr Barnett, who then goes on to examine the Chinese Communists' military strength and their attitude to war. His estimate of 'over 150 divisions' for the ground forces is higher than is accepted in Britain (where the figure is believed to be about 110), but his picture of the Chinese Army as the largest and most formidable *pre-atomic* force in the world is convincing both in its presentation and its detail. On the possible acquisition of atomic or hydrogen weapons by China, Mr Barnett is cautious: he quotes statements by Chinese Communist leaders such as the Foreign Minister, Ch'en Yi, that China will eventually obtain these weapons or make them herself, but he adopts the view that the Chinese leaders for the present are satisfied to leave the Communist bloc's nuclear deterrent in the hands of the Soviet Union. On the subject of rocket bases in China, the author is content to recall Mr Averill Harriman's report of his conversation with Khrushchev, in the course of which the Soviet leader stated that 'Russia had shipped numerous rockets to China'.

Nevertheless, it is clear from Mr Barnett's analysis that there is a divergency of views between Moscow and Peking on the effect of the use of nuclear weapons if used in a future war. In 1950, both Soviet and Chinese statements on the atomic bomb played down its effectiveness, the Chinese saying that the bomb cannot be the decisive factor in a war. Since 1955, Soviet military writers have moved steadily towards a more realistic view of these weapons, and now, in 1960, have quoted Lenin to the effect that their deterrent value could in fact prevent the

outbreak of war. The author shows that the Chinese, while modifying some of their attitudes on the bomb, have not caught up with the Soviet point of view, and the recent exchanges in the Soviet and Chinese press on the subject have confirmed that the gap is even wider than appeared to be the case when this book was prepared.

Mr Barnett sees the Sino-Soviet military relationship as firm, and fundamentally controlled from Moscow. This is largely due to the superior technical position of the Soviet Union and her armed forces, and her large measure of control over China's military supply position. In an interesting passage he quotes a leading Chinese Marshal, Yeh Chien Ying, as saying that in a new world war 'the major and decisive battlefield will be Europe', and recalls that in 1955, the Chinese Minister of Defence undertook to support military action taken by the Warsaw Pact 'until final victory'.

The author sums up his conclusions on China's attitude to war in these words:

> If a major war involving Communist China were to break out . . . Peking might ignore the restraints which had limited its range of action prior to that event – including both the external restraints imposed by fear of American atomic power, and self-imposed restraints arising out of its overall political strategy. In this case it would presumably strike out in several directions, specifically against South Korea and South East Asia. *It is by no means certain that even atomic weapons could stop an initial surge of Chinese military manpower into neighbouring countries* . . . (my italics). There is no guarantee that, even if all the key centres of power in Communist China were destroyed, Chinese Communist military manpower might not still spread out, living off the land and carrying out local military actions over large parts of Asia.

This is surely the crux of all analyses of Communist China's military capabilities.

Mr Barnett goes on to examine China's ability to subvert and penetrate South East Asia politically and economically, and rates her chances good unless the Western Powers, led by the United States, undertake a positive policy based on understanding of Asian fears and political outlook. One point on which it might be possible to challenge him is his assertion that 'neither ideological stresses nor problems of policy co-ordination are likely to determine the future of the Sino-Soviet alliance; military and economic factors will probably be far more crucial'. There is a tendency to see 'ideology' as a battleground only for professors of Marx-Leninism, working in Political Academies, whereas, in the Soviet and Chinese context, it is very nearly life itself. The Sino-Soviet alliance is primarily an ideological and political alliance, and, without denying the importance of military and economic factors, it seems likely that if the two Communist Parties really quarrelled on 'ideology', there would be little to hold them together, ruled, as they would be, by men whose views on the future of the world were radically different. This is not to argue that such a split is near or even inevitable, for Mr Barnett makes a convincing case in his conclusions for extreme caution in predicting Sino-Soviet friction. But to underestimate the significance of ideology in maintaining the Sino-Soviet alliance in the minds of men like Mao Tse-Tung, whose whole career was built on his belief in the Communist doctrine, would surely be unwise.

Mr Barnett's book, which is thoroughly documented, is a massive contribution to the understanding not only of China itself but of Communism in Asia, and his scholarly and objective treatment of the issues involved makes it essential to all students of the international situation. He does an excellent job in putting China and Chinese Communism into perspective in the modern world.

MALCOLM MACKINTOSH

CONTROLS FOR OUTER SPACE

And the Antarctic Analogy

Philip C. Jessup and Howard J. Taubenfeld:
New York: Columbia University Press
London: Oxford University Press, 35s.

The first missile Powers contemplate space with the perspective of the first oceanic naval Powers, when they contemplated the globe. Their legal conceptions do not cover it; they do not know what importance it will have for them, or even, strictly speaking, what it is. In the way of guidance their experience provides them with very little except analogies. This is the starting point of this masterly survey, which must immediately become the handbook of anyone concerned with the place in international relations of outer space.

The first part of the book, dealing with 'Controls in Retrospect', presents a compendium of information upon numerous past instances of international control, from the Anglo-French condominium (or, as it is called by those who know it, pandemonium) of the New Hebrides, to the neutralization of Spitzbergen. This pursuit of exhaustiveness is somewhat wearisome, and leads to a certain shallowness. The idea of the relevance of all these past forms of control to the problem of establishing controls for outer space now, depends upon the assumption that each of these controls can be abstracted from its context: the Cook's tour of the history of controls on which we are conducted appears to lead through a vast storehouse of possible devices from which we are invited to take our pick. But the excursion does leave us with a proper sense of the great variety of things that are meant by 'international control'.

The second part of the book deals with the close analogy of the Antarctic: empty, uncharted, of uncertain

legal status and economic potentialities, subject to the intrusion of international anarchy, but offering the promise of insulation from it because human activities there are still at the threshold.

The third part contains a comprehensive account of outer space: its physical character, the military and civil uses to which it has been and may be put, the legal controversies about it, the course of discussion about it in the United Nations and in disarmament negotiations, the possibilities of subjecting it to demilitarization and international control. The three forms of control to which the authors give most prominence are: that the space Powers be controlled by a system of trusteeship, under which they should be authorized to administer space on behalf of the UN; that they should be controlled by legislative power vested in the General Assembly or some new body; or that there should be direct, supranational administration.

Some tentative conclusions suggest themselves. The relations of the Great Powers cannot be expected to obey one set of laws on earth, and another in outer space. If politics and war are the ruling order in the one, it is unlikely that they can be excluded from the other (particularly if national prowess in outer space – here the Antarctic analogy breaks down – promises huge rewards in political prestige, and major military advantages). The most illuminating analogies are perhaps not those with the history of international controls, but those with the movements of arms races and political conflicts from old to new places and technologies. If outer space and space technology in the course of the next fifty years become a commonplace of our environment, as air space and air technology became in the course of the last, it is likely to be affected by the habit of war, if that habit persists. Whether the spread of the arms race into outer space will constitute a grave danger to international security, we do not know. It is conceivable that in the long run space technology will bring forth weapons of such significance as to upset the balance of power; or that space exploration will lead to the discovery of something of such economic significance as to produce a scramble for it (say, the philosopher's stone). But as far as we can see ahead now, military activities in outer space (apart from the earth-to-earth missiles that pass through it *in transit*) are of very slight importance compared with military activities on earth. The chief source of anxiety at present must be that incidents may occur in outer space (like the shooting down of reconnaissance satellites) which (like the shooting down of reconnaissance aircraft) are of little military significance in themselves, but a source of political tension on the earth below. It is the possibility that military activities in outer space are relatively very unimportant, that gives most promise that they may be controlled. At the same time, it is the immense political importance which the space Powers attach to demonstrating their technological prowess that makes most questionable the idea that they will subject themselves to any rigidly supranational controls in this field.

HEDLEY BULL

SURVIVAL

Edited by John M. Fowler:
New York: Basic Books, $5.50 (entitled *Fallout*)
London: McGibbon and Kee, 18s.

Fallout, the American title, is a deceptive one for this book which surveys the whole range of hazards arising from nuclear weapons, although the question of damage due to fallout from weapon tests is discussed at length in the text. The fault of the book lies in the fact that it attempts to cover so much. The form of damage done to human beings by large doses of radiation caused by the explosion of a bomb nearby is of quite a different order from that caused by the traces of radioactivity which fall out over the surface of the Earth thousands of miles from the site of a nuclear weapon test.

The difference in opinion between scientists on the likely damage caused by fallout from tests has resulted in a loss of public confidence in the pronouncements of science. It has also resulted in a measure of exaggeration about what these actual dangers are. The arguments obscure the important facts: first, if, as seems likely, some genetic and somatic damage is done by fallout from nuclear test explosions, all scientists agree that the risk is small; secondly, because the risks are so very small at low radiation intensities nobody has yet been able to determine directly by experiment what their magnitude is.

In themselves, these points are not remarkable. There are thousands of other things – chemical substances, patterns of behaviour and the like – which entail similar small but indeterminate risks, and no one worries greatly about them. But in the case of fallout there are additional factors at work. First, there is the moral attitude towards nuclear weapons; second, there is the irrational fear of radiation; and third, there is the simple fact that radiation can be easily detected in quantities far smaller than could possibly be detected in other ways, for instance by a chemical test. Thus a factory may, without knowing it, pollute the atmosphere with a much more significant quantity of carcinogen, such as benzpyrene, than has reached the local population so far as a result of nuclear weapon tests.

The authors of the various chapters in this book overlook this basic approach and become embroiled in unsatisfactory arguments about the actual level of harm done. The arguments are interesting for the professional scientist, but it is unconvincing for the layman to be presented with figures based on the response of fruit flies to radiation or the shortening of the lives of mice subjected to much higher radiation doses than those with which we are concerned.

A more satisfactory approach is surely to take the worst estimate of the damage likely to be done. On an individual basis this means that the chance of getting leukaemia as a result of the tests is 1 in 100,000 and the risk of all other cancers together is about the same. The genetic risk is more difficult to calculate, but the chance of a child

inheriting a mutation as a result of the tests which have taken place so far is about the same: 1 in 100,000.

The moral question is whether this degree of individual risk is acceptable in return for the benefit bestowed by nuclear weapons. Those who believe that nuclear weapons serve no purpose will be unwilling to accept even this small risk. But if the possession of nuclear weapons has done anything to add to the stability of the world, the risk is worthwhile. In this case we have to equate the total number of people affected by the tests with those who might be killed in a small war and the famine and epidemics such a war might bring about.

The tests to date have probably resulted in 20,000 mutations, a proportion of which may be fatal. A further 40,000 people may have their life span reduced by contracting leukaemia or cancer. The figures are small compared with the numbers killed in a war like that in Korea.

TOM MARGERISON

POLITICAL REALISM AND THE CRISIS OF WORLD POLITICS

Kenneth W. Thompson:
Princeton University Press. London: Oxford University Press, 40s.

Mr Kenneth Thompson, a well-known American political scientist, has re-printed with rather too little revision a series of lectures given in 1958 which attempted to place some of the debates on American foreign policy and its conduct into historical perspective.

He begins by examining the way in which the reaction to the excessive utopianism and legalism of American writing on foreign policy in the inter-war years has developed. He shows that this reaction derives its intellectual backing from a number of sources: philosophers such as Rheinhold Niebuhr; students of geo-politics of the school of Nicholas Spykman; professional students of politics with a European background like Hans Morgenthau; worldly-wise columnists like Walter Lippmann and the Alsops; and finally and most important of all, disillusioned former members of the State Department itself – George Kennan, C. B. Marshall and Louis Halle. Mr Thompson then goes on to examine the institutional difficulties which makers of American foreign policy confront, and endeavours to show that the British parliamentary system is largely free from the weakness he detects in America. The case here is not very convincingly made out, and it is perhaps a pity that his example of realistic political discussion is Parliament's handling of Yalta rather than some incident arising in a more normal parliamentary situation.

Finally, Mr Thompson examines some of the principal problems facing American policy today, paying due attention to the factor of power, though he says less than one would have liked on the implications for policy of technological development and on the crisis in the structure of American government that it has helped to provoke. Mr Thompson has not tackled, as one would like to see him do some day, the question as to how far this high level debate on American policy has affected the thinking of the ordinary Congressman and citizen voter.

MAX BELOFF

COMMON SENSE IN DEFENCE

Sir Stephen King-Hall:
K-H. Services Ltd., 2s. 6d.

Sir Stephen King-Hall is known as a trenchant critic of official humbug and his reputation as a slayer of dragons has been extended since he recently turned his attention to the problems of grand strategy. In this pamphlet he condenses and brings up to date the arguments he put forward two years ago in his *Defence in the Nuclear Age*. He assaults his readers, as they cannot be assaulted too often, with a reminder of the catastrophic nature of nuclear weapons: points out the fallacies in the theory of deterrence: adduces well-known arguments to demonstrate the difficulty of maintaining the credibility of a British deterrent: adds one more voice to the growing volume of scepticism about the value of tactical atomic weapons: and rounds it off with a series of arguments, some valid, some dubious, to remind us of the quite novel strategic situation which confronts the United Kingdom.

It is when he leaves diagnosis for cure that he also leaves most responsible students of international security behind. Britain should renounce not only her nuclear weapons but her contribution to the non-nuclear forces of NATO. Since NATO has evident weaknesses he would abandon it to its fate, a policy whose blatant selfishness seems to leave the author untroubled since it is clear that two wars have taught him little about the need for collective security. Sir Stephen is not so much a unilateralist as an isolationist and his philosophy is in fact that of the 1957 White Paper with the hourglass inverted so that the Sandys run up-hill. Once this cheap and convenient decision had been taken, Britain would need merely a military force for internal security (I wonder if he has consulted the TUC on this one) and for colonial commitments, while its inhabitants watch, with guilt-free hands, the United States and the Soviet Union hurling missiles at each other. If the latter wished to occupy this country, we could not prevent it but it would hardly be worth her while. 'The English State', a German critic wrote in 1922, 'rests on two specifically English assumptions, common sense and the transformation of the antagonist into a privileged colleague.' In making this second assumption, Sir Stephen has perhaps jeopardized the first.

ALASTAIR BUCHAN

The Arms Race by Philip Noel-Baker has now been published as a paperback by John Calder Ltd. at 12s 6d.

Printed in England by A Quick & Co (Printers) Ltd 125 High Holborn London WC1 *also at* Clacton-on-Sea